State of California

THE RESOURCES AGENCY

Department of Water Resources

BULLETIN NO. 145

AGUA FRIA INVESTIGATION

Feasibility Study

AUGUST 1964

HUGO FISHER
Administrator
The Resources Agency

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Director
Department of Water Resources

CORE DRILLING ON AGUA FRIA DAMSITE AXIS DURING OCTOBER OF 1963

State of California

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M E. WARNE
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STATE OF CALIFORNIA

Department of Water Resources

SACRAMENTO

July 31, 1964

Honorable Edmund G. Brown, Governor,
and Members of the Legislature of
the State of California

Gentlemen:

I have the honor to transmit herewith Bulletin No. 145, entitled, "Agua Fria Investigation: Feasibility Study." This study was conducted under terms of an agreement between the Department of Water Resources and the Mariposa County Water Agency as directed by the 1963 Legislature (California Statutes 1963, C. 1854, p. 3830).

The objective of the study was to investigate the feasibility of a proposed multiple-purpose development of the waters of Mariposa Creek and its main tributaries of Agua Fria and Buckeye Creeks. The proposed project would provide a major recreation potential, enhance the fisheries, serve domestic water to lands north of the proposed reservoir including the town of Mariposa, and provide a source of agricultural and domestic water for the area of Catheys Valley.

The study determines that there is a definite need for the proposed project and that the project is engineeringly feasible, economically justified, and financially feasible.

Sincerely yours,

William E. Warne

Director

Enclosure

State of California
The Resources Agency
Department of Water Resources

EDMUND G. BROWN, Governor
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SAN JOAQUIN VALLEY BRANCH

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The Department of Water Resources gratefully acknowledges the information and assistance provided by personnel of various agencies of the federal and state governments and in particular the personnel of the government of Mariposa County.

Special mention is made of the helpful cooperation of Mr. John Anderson, Mariposa County Farm Advisor. His work on the project prior to and during the preparation of this report was indispensable.

A debt of gratitude is owed to the local property owners who were so cooperative during the field exploration phase of this investigation. Special mention is made of Mr. Phil Rauch and his staff, Mr. Luther Bagwell, Mr. Clair Wolfsen, Mr. Frank Long, Mr. S. F. Smith, Mr. Will Irwin, Mr. Dale Hudson, and Mr. R. M. Whitmore.

CHAPTER I. INTRODUCTION

During the 1963 Regular Session, the California Legislature authorized the Department of Water Resources, contingent upon the completion of specific agreements between the Department of Water Resources and the Mariposa County Water Agency, to prepare a feasibility report on the proposed Agua Fria Project on Mariposa Creek in the County of Mariposa. This legislative directive (1963 Statutes, Chapter 1854) is included in this report as Appendix A.

The specified agreements between the Department of Water Resources and the Mariposa County Water Agency were subsequently achieved, and a formal contract was signed on July 16, 1963. A copy of this contract is contained as Appendix B of this report. Soon thereafter the department began the investigations needed to prepare this feasibility report. Contracts were negotiated with the Department of Parks and Recreation and the Department of Fish and Game for necessary recreation and fisheries investigations. The California Department of Public Health also furnished comments on proposed water supply and sanitary facilities for the proposed project. These comments are contained as Appendix C of this report. This feasibility report is a compendium of the work of the following agencies of the State of California:

Department of Water Resources, San Joaquin Valley Branch

Department of Fish and Game

Department of Parks and Recreation, Division of Beaches and Parks

Department of Public Health

Mariposa County

Mariposa County was one of the 27 original California counties which were formed at the time when the State's boundary lines were drawn in February 1850. Its boundaries then encompassed a broad expanse of land from the Coast Range on the west to the Utah Territory on the east, and from Tuolumne County on the north to the summit of the Tehachapi mountains on the south. Within these borders were the highest and lowest elevations in the United States.

Ghost towns, old adobe buildings, an ancient Chinese cemetery, and other relics of the past testify to the county's participation in the gold rush which brought miners and adventurers to the Mother Lode country.

Of the sprawling 30,000 square miles which originally comprised the county, now only 1455 remain within its boundaries. Mariposa County lies along the west slope of the Sierra Nevada, extending from the Tuolumne-Merced River Divide on the north into the headwaters of the Chowchilla and Fresno Rivers on the south. The western portion of Mariposa County encompasses the foothill drainage basins of the streams of the Eastern Merced County Stream Group, and the eastern one-fourth of Mariposa County lies within the boundaries of world-famous Yosemite National Park.

Mining is no longer a major attraction but the county is one of California's important scenic, historical, and recreational areas. Visitors by the thousands are attracted by world-famous Yosemite Valley, the giant groves of Sequoias, and the lure of hunting and fishing.

Climate

The climate of Mariposa County is characterized by warm summers and mild winters with little rainfall during late spring, summer, and early fall, but with comparatively heavy precipitation during a few winter months. The entire county follows this general pattern, but there are large differences in both temperatures and precipitation within relatively short distances because of variations in elevations and exposure.

Summers at the lower elevations are quite hot with daily temperatures in the mid-nineties, but the area cools off at night. This nighttime drop in temperature averages about 35 to 40 degrees. The summer daytime temperatures at the higher elevations are moderate with very cool nights.

Temperatures during winter, spring, and fall are relatively mild in the vicinity of the town of Mariposa. At elevations below 1,500 feet in the Mariposa area the average daily minimum temperatures are above freezing even during January, the coldest month, although temperatures as low as 10 degrees F. have been recorded. At the higher elevations in the area, winter daily maximum temperatures are generally above freezing, but nighttime temperatures are usually well below freezing. Minimum temperatures below zero are not uncommon at elevations above 6,000 feet.

Most of the precipitation in the Mariposa area occurs from storms sweeping in from the Pacific Ocean from October through April. Approximately 93 percent of the total precipitation occurs during this period. Average annual precipitation increases with elevation -- from 10 inches along the Merced County boundary in the west to over 50 inches along the summit of the Sierra Nevada in the east.

Population and Income

The population of Mariposa County decreased after a high point in 1940 but is on the upswing again. The decrease was largely due to a general migration of young people to the armed forces and to defense industries. The recent uptrend in population is attributed principally to improvement in businesses serving tourists and vacationers. The 1960 census places the population of Mariposa County at 5064. The estimated present population of the county is 5500.

Income levels in Mariposa County are lower per capita than in the more populous California counties. The per capita income of Mariposa County in 1959 was 2,370 dollars per annum. This amount was lower than the state average of 2,678 dollars per annum.

Economic Potential

The present shortage of economically harvestable resources is retarding the growth of Mariposa County. Production of timber is at a low level and not likely to increase in the near future. Mineral processing is also at a low level, but there are known deposits of some minerals which may offer possibilities for future development. Agricultural output has been concentrated in livestock, poultry, and poultry products due primarily to a shortage of irrigable land and the problems involved in supplying sufficient water to those few and scattered areas where irrigation could otherwise be feasible.

Recreation and tourism offer the greatest potential for the future economic growth of Mariposa County. Development of choice recreational sites and dramatization of the fascinating history of the

area, combined with the existing pleasant climate and scenic beauty, would undoubtedly attract many tourists and vacationers the year around. Development of domestic water supplies and other resources in selected areas would encourage the rapidly increasing number of retired people to reside in these areas. Also, proximity to fast growing San Joaquin Valley towns would allow many people who are presently employed to commute to work from the area.

All of these things combine to create more jobs, new service industries, and a broader tax base. Herein, it seems, lies Mariposa County's gold mine of today and tomorrow. It was with these things in mind, no doubt, that the number one recommendation of the Planning and Survey Committee of the Mariposa County Chamber of Commerce in cooperation with the State Economic Development Agency was to concentrate effort on the proposed Agua Fria Project.

Local Governments, Districts, and Agencies

Mariposa County is governed by a Board of Supervisors consisting of five members who are elected, one from each of the five county districts. It is their direct responsibility to administer all county services.

There is no city government in Mariposa County and only a few special districts governed by boards other than the County Board of Supervisors. There are two soil conservation districts, one public utility district, one hospital district, and one unified school district.

The Mariposa County Water Agency was formed in July of 1959. The water agency is a dual function of the Board of Supervisors. The agency is authorized to plan and construct flood control, water conservation, and hydroelectric power facilities, issue bonds for these

purposes subject to approval of affected voters, and to levy taxes up to 10 cents on each 100 dollar property valuation.

Study Area

The Agua Fria Project is envisioned to provide primary benefits in the form of dependable water supplies to the town of Mariposa, the general environs surrounding the proposed reservoir area, and Catheys Valley. These three general localities comprise the immediate area for the project feasibility study; however, the potential benefits to the entire county have also been considered during the investigation. The studies by the department have also included an appraisal of state-wide benefits which would be derived from the proposed project.

Agricultural Potential

Due to the complex topography and heterogeneous conditions of soil depth and fertility, agriculture in Mariposa County consists principally of scattered farms or groups of farms in those areas where the soil is relatively deep and where water ponds can be created for stock watering and irrigation purposes. With few exceptions the lands are devoted to livestock and poultry production. Water has not been a critical factor for these operators.

There are very few large areas in Mariposa County where topography and soil conditions are reasonably favorable, where significant quantities of water could be developed nearby, and where an irrigation system of canals and laterals could be developed at a reasonable cost. The only area which appears to have an economical demand for agricultural

water from the proposed Agua Fria Project is in Catheys Valley. That demand and the facilities proposed to supply it are discussed in Chapter II of this report.

Industrial Potential

Industrial development within Mariposa County is very limited and consists almost exclusively of the processing of either forest or mineral products. Neither of these industries offers much promise for future economic expansion. The timberlands have been overcut, and too often reforestation has been disregarded because of the recently depressed conditions of the industry in general. Mineral production has shown a downward trend for some time and is not expected to do much better than remain static in the future unless gold prices should be increased or stockpiling of strategic materials were resumed and accelerated. In any event, water supply is not a factor in the present industrial development of Mariposa County nor is it expected to become a major factor in the foreseeable future.

Recreation and Suburban Development Potential

In areas where recreation or multipurpose reservoirs have been constructed, a more or less extensive suburban development has soon followed. Examples of such development can be seen in the Pinecrest area of Tuolumne County, in the Bass Lake area of Madera County, and in the Folsom Lake area of Sacramento County. The majority of homes recently constructed in these areas are designed for permanent occupancy. For the most part they are the culmination of the dreams of retired people who have

worked and saved and planned for years in the hurry and congestion, the fog and smog, or perhaps ice and snow of the city. Some are being built by the increasing numbers of middle-aged men retiring now from the military service after careers which began with World War II. Quite a few are being constructed by persons who commute from their businesses or job locations. In any case the number of such homes will increase more rapidly in future years.

It can be assumed that most of the citizens of Mariposa County want to see their county share in the economic growth and development of California and have been disappointed with its past performance in that regard. Many Mariposa County residents have evidenced an increasing awareness that tourism and recreation, including the suburban development which is thus stimulated, represent their greatest hope for improving future performance. That fact is manifest by the interest they have shown in this proposed project.

Related Investigations

Investigations of possible water conservation projects on Mariposa Creek were conducted by the Department of Water Resources and its predecessor agency, the Division of Water Resources, during the early 1950's. "The California Water Plan" includes a 15,000 acre-foot reservoir at Agua Fria site, with conveyance facilities to adjoining lands.

The U. S. Corps of Engineers conducted flood control studies of the Merced County Stream Group between 1946 and 1948. Construction of Mariposa Dam on Mariposa Creek in 1948 resulted from those studies. This dam is located near the Merced County boundary. Recent developments

have indicated that additional flood control measures should be considered, and the Corps of Engineers is currently resurveying streams of the Merced County Stream Group.

The Department of Water Resources has recently completed the "Mariposa Area Investigation," which is a comprehensive investigation of the water resources of Mariposa County and contiguous drainage basin. A report on this investigation is now in preparation. Studies under that investigation included a preliminary appraisal of the Agua Fria Project.

CHAPTER II. ENGINEERING

Because of the outstanding recreation characteristics offered by the topography of the reservoir site and surrounding areas, the Mariposa County Water Agency began the initial steps toward development of the Agua Fria Reservoir. The agency sought state assistance under the provisions of the Davis-Grunsky Act. Departmental findings issued early in 1963 were negative as to eligibility under the act because the primary purpose of the project was recreation; however, it was stated that a 50,000 acre-foot project "would probably maximize the water resource potential of this outstanding reservoir site and accomplish the objectives of the California Water Plan." During the 1963 session of the State Legislature the Davis-Grunsky Act was amended to recognize recreation as an eligible project purpose, and the 50,000 acre-foot Agua Fria Reservoir became an eligible project under the amended act.

As presently contemplated, the Agua Fria Project would be composed of the following main features:

(1) An earthfill dam 178 feet in height, located on Mariposa Creek approximately 1,000 feet below the confluence of Agua Fria Creek, lying in the northeast quarter of Section 15, Township 6 South, Range 18 East (Mount Diablo Base and Meridian). The proposed dam would contain approximately 720,000 cubic yards of material and would have a crest length of 625 feet. The elevation of the crest of the dam would be 1,508 feet.

(2) A side channel spillway capable of passing a 20,000 second-foot maximum probable flood outflow without overtopping the dam.

(3) Outlet works through the right abutment to allow releases to Mariposa Creek and diversions to Catheys Valley.

(4) A domestic water supply intake on the upper reaches of the Buckeye Creek arm of the proposed reservoir, water treatment plant, storage facilities, and main distribution lines. These proposed facilities would serve the lands north of the reservoir, including the Mormon Bar area and would provide a supplemental source of water to the town of Mariposa.

(5) A pipeline and canal to convey domestic water to a second treatment plant and distribution system in Catheys Valley and to convey agricultural water to lands below the canal.

(6) A reservoir with a storage capacity of 50,000 acre-feet and with a surface area of 1,260 acres. A maximum drawdown of about 25 feet is estimated to occur four times during a 42-year study period. Normal or average annual drawdown of the reservoir would be approximately 10 feet and the corresponding surface area would be 1,060 acres. A long peninsula would allow a natural separation of recreation activities and would provide an ideal location for public recreation facilities. Lands surrounding the reservoir would be for the most part gently sloping with abundant shade from predominantly oak cover.

The proposed Agua Fria Project would accomplish the following purposes:

(1) Provide a superior year-round recreation facility for the fisherman, water skier, skin diver, swimmer, boater, camper, picnicker, hiker, and nature lover.

(2) Furnish a supply of urban and rural homesite water to three service areas: Catheys Valley, Mariposa, and lands north of the reservoir including Mormon Bar.

(3) Provide a source of agricultural water for portions of Catheys Valley.

(4) Provide incidental flood control benefits to the lower reaches of Mariposa Creek.

(5) Provide for a greatly accelerated growth of Mariposa County as a result of associated economic activities.

This chapter will be concerned with the physical aspects of the project feasibility - the suitability of existing conditions, the various features of the project, and the costs involved in building those features.

Summary of Geologic Investigation

The purposes of the geologic investigation conducted under the Agua Fria feasibility study were to determine the adequacy of foundation conditions and to locate construction materials for the proposed dam. The geology of the area is shown on Plate 1, entitled "Location of Investigated Area and Regional Geologic Map." Geologic explorations conducted during the fall of 1963 included detailed geologic mapping of the damsite, and diamond core drilling of eight foundation holes. Results of these explorations are shown on Plate 2, entitled, "Areal Geology and Section A-A', Agua Fria Damsite." Location of drilling and sampling of 22 auger holes in the proposed borrow areas, supplementing the 22 auger holes previously drilled during August of 1958, are shown on Plate 3, entitled "Location of Construction Materials, Agua

Fria Damsite." Laboratory tests were performed on soils and rock samples to determine their suitability for use in construction of the dam.

The results of the geologic investigations are summarized below. A complete geologic report including summaries of tests on potential construction materials and logs of drill holes is presented in an Office Report. A limited number of copies of that report are on file at the office of the Department of Water Resources.

The Agua Fria damsite and the Agua Fria Creek branch of the proposed reservoir would be predominantly on schist and hornfels of the Mariposa Formation; the Mariposa Creek and Buckeye Creek branches of the proposed reservoir would be predominantly on granitic rock. Tilted beds of unweathered schist and hornfels are continuously exposed along the channel section of the damsite. The unweathered schist is gray-black, hard and competent, and exhibits a strong foliation, generally parallel to the bedding plane cleavage. The bedding plane cleavage trends North 45° West approximately parallel to the damsite axis and dips 50° to 75° northeast or upstream. The bedding can be traced across the bottom of the stream. The hornfels, not widespread in occurrence, is also gray-black, hard, and competent but is massive to slightly foliated.

Uphill from the channel on both abutments, schist and hornfels become more weathered and the occurrences of bedrock outcroppings become increasingly spotty and discontinuous.

The Agua Fria damsite appears geologically suitable for the proposed earthfill dam. An estimated 5 to 10 feet of stripping would be required on each abutment, and only shaping of the bedrock would be

required along the channel section. The cutoff depth requirement on the right abutment is estimated to be 15 feet, while on the left abutment it is estimated to be somewhat deeper. Water testing of the foundation drill holes indicates grouting of the damsite would be required. It is estimated that a grout curtain would be required with grout holes on 5-foot centers to a depth of 50 feet in the channel section and 75 to 100 feet on the abutments. Grout take is estimated to range from light to moderate -- 0.2 to 2.0 cubic feet per linear foot of hole.

A side channel chute spillway may be adequately founded on either abutment and either location would require a cut in excess of 50 feet in depth in the weir section. The left abutment site would require a shallower cut, but due to a greater degree of weathering of the schist, a flatter side slope cut, perhaps $1\frac{1}{2}$:1 with berms, would be required. A deeper spillway cut would be required above the right abutment site but the side slope would stand on a steeper cut slope of 3/4:1. Concrete lining and a cutoff probably would be required at either site.

Much of the excavated rock from the spillway site on the left abutment might have to be wasted or used for random fill. Larger residual schist boulders suitable for riprap could be salvaged. A higher percentage of excavated materials from a spillway cut on the right abutment would be salvable for riprap and/or rockfill. This opinion is substantiated by laboratory tests of core samples obtained from a drill hole at this site. The re-entry and stilling basin for either spillway site would be on sound rock.

With the reservoir founded entirely on crystalline metamorphic rocks and granitic rocks, reservoir leakage should be negligible. Silting potential, though difficult to determine, is estimated to be light or light to moderate.

A sufficient quantity of suitable impervious materials for the proposed earthfill dam appears to be available within a 2-mile radius. Laboratory tests of spot samples from eight potential areas indicate the impervious material to be predominantly a non-plastic silty sand. The five principal sources are weathered-in-place decomposed granite; the three other sources are weathered schist.

Riprap may be obtained by sorting the desired sizes of unweathered schist boulders from the proposed spillway cut. If necessary, this source may be supplemented by opening a granitic rock quarry approximately a mile northeast of the damsite. The usable volume of granitic rock for riprap or rockfill should be substantial.

An undetermined quantity of sand and gravel occurs in several deposits within $2\frac{1}{2}$ miles of the damsite. The two largest deposits are located along Agua Fria Creek one-quarter mile upstream from Bridgeport, approximately $1\frac{1}{2}$ miles northwest of the damsite. Locally these deposits had been dredged for gold. The Division of Highways, District X, sampled and tested these gravel deposits as part of its local materials investigation in the Mariposa area. Laboratory mechanical analysis reveals that these gravel deposits are fairly well graded. It is estimated that the quantity of materials from these two sources would supply the filter and aggregate requirements of the proposed dam. Other local nearby sand and gravel deposits, though smaller in volume, are located upstream and downstream from the damsite along Mariposa Creek, and also along Agua Fria Creek just upstream from its confluence with Mariposa Creek.

Although earthquakes occur in all parts of the world, those that occur on land are generally concentrated in certain well-defined seismic belts. California lies within one of these seismically active belts. The Sierra Nevada is placed within the areas of the lowest probable maximum intensity. The more stable areas are highly elastic crystalline rocks in which the intensity of a seismic shock of given magnitude is lower than in inelastic less consolidated rocks. Hence, the seismicity of the area may be considered low to moderate. The nearest active fault, perhaps, is located approximately 50 miles to the northeast along the eastern Sierra Nevada escarpment.

The foregoing findings and estimates based on exploration studies are considered adequate for feasibility stage construction cost estimates. This stage of exploration should be followed by a final design stage of exploration prior to construction, and emphasis would shift from a more qualitative to a more quantitative basis.

Preliminary Designs

Specific determination of the type of dam, i.e., rockfill or earthfill, cannot be made until more extensive exploration and investigation is accomplished along the axis of the proposed spillway. This further investigation would determine whether a concrete lined spillway would be required or whether an unlined channel could be provided in the side of the abutment. It is anticipated that, should the spillway not require lining, much of the rock removed from the spillway cut could be used in the construction of the dam and that the quantity of rock removed would be nearly sufficient for the construction of a rockfill dam with a central impervious core to be constructed of borrow material. This type of dam is shown on Plate 4, entitled "Preliminary Design, Scheme 1."

Should the character of the spillway cut be such as to require a concrete lining, it is anticipated that the quantity of excavation would be held to a minimum. In this case, the dam would be an earthfill type constructed primarily from borrow material. This type of dam is shown on Plate 5, entitled "Preliminary Design, Scheme 2."

Judging from the geologic exploration accomplished during this investigation it appears that the latter case will apply, and that the spillway excavation would be utilized as random fill with selected portions used in the construction of a toe drain.

It is considered that the outlet works would consist of a single rectangular opening protected by a trashrack and vertical slide gate, a transition section, and a 36-inch diameter pipe sealed in a trench cut through the right abutment. Above the opening, a tower structure

would project above the water surface. This structure would support the gate and trashrack guides and lifting mechanism. It would be bridged to the shoreline.

The invert elevations of the outlet works are set to provide what is considered to be sufficient allowance for emergency lowering of the reservoir, minimum outlet structure dimensions, and a system whereby the dam and outlet works could be independently constructed.

Initial studies indicate the possibility of a two-season staging for construction of the dam, spillway, and outlet works with the dam constructed to an elevation of about 1,460 feet during the first season.

Preliminary cost estimates have been made for each of the two design schemes.

Relocations of Roads

Existing roads in the area of the reservoir are shown on Plate 6, entitled "Proposed Relocations." The proposed relocations of roads are also shown thereon. The plan has been reviewed by the supervisors and road commissioner of the county.

There is only one major structure that would be required. Near the old settlement of Bridgeport, a new bridge approximately 400 feet long and maximum 25 feet above streambed would be constructed. Foundation conditions appear to be excellent for the bridge piers. Other small bridges indicated on the plan could be culverts under relatively high fills.

Relocation of Utilities

The Pacific Gas and Electric Company and the Mariposa Telephone Company have overhead service lines in the proposed reservoir area which, in general, make joint use of the pole lines. Both firms were cooperative in providing assistance with estimating the cost of relocating the affected facilities.

Land Acquisition for Proposed Project

The locations of existing ownerships, property lines, and proposed boundaries of land acquisition for the project are shown on Plate 7, entitled "Land Ownership and Proposed Acquisition Lines." Aerial photographs were taken on September 14, 1963, and subsequently a detailed map was compiled with a scale of one inch equals 400 feet. The ownerships and private property lines are those in existence as of January 1, 1962, with the exception of a few small acreage holdings which were not included thereon. Since that time the ownerships of the major properties have changed very little, but there has been some increase in the number of small acreage holdings within the area proposed for acquisition. It is estimated that should property be acquired at the present time the negotiations for property acquisition would involve approximately 50 ownerships. Costs of proposed property acquisitions have been estimated from appraisals made during November, 1963.

Boundary lines of the property proposed for acquisition are located a minimum of 100 feet back from the high water line of the proposed reservoir except for the lands set aside for public recreation, wildlife management, future recreation development or water treatment

and storage facilities. The 100 feet minimum distance from shoreline is considered necessary for shoreline maintenance and control. The maximum distance from shoreline was determined by compromising the desire to acquire a minimum control strip with the practical necessity of holding the courses of the boundary traverse down to a reasonable number.

Cost Estimates, Dam and Reservoir

It has been previously stated that two types of dam and spillway construction are expected to be considered for Agua Fria. On the following pages are cost estimates for each type. Table 1 presents estimated costs for the rockfill type dam with central impervious core and unlined side channel spillway (Scheme 1). Table 2 shows the estimated costs for earthfill construction and concrete lined spillway (Scheme 2).

TABLE 1
ESTIMATED COSTS OF AGUA FRIA DAM AND RESERVOIR - SCHEME 1

Type of dam: Rockfill w/ impervious core
Elevation of dam crest: 1,508 feet
Elevation of crest of spillway: 1,494 feet
Height of dam above streambed: 178 feet
Storage capacity: 50,000 acre-feet
Spillway discharge: 20,000 second feet max. probable flood

Item	Quantity	Unit price	Item cost	Total cost
CAPITAL COSTS				
Dam				
Diversion and care of stream		lump sum	$ 10,000	
Stripping foundation area:				
Rock	6,000 cu yd	2.00	12,000	
Common	60,000 " "	0.60	36,000	
Stripping borrow areas	25,000 " "	0.25	6,250	
Excavation and haul:				
Pervious, salvage	238,000 " "	0.25	59,500	
Filter	18,000 " "	3.50	63,000	
Rock spalls, salvage	18,000 " "	0.75	13,500	
Impervious, borrow	257,000 " "	0.45	116,000	
Placing and watering:				
Pervious	300,000 " "	0.30	90,000	
Filter	24,000 " "	0.20	4,800	
Rock Spalls	24,000 " "	0.20	4,800	
Impervious	230,000 " "	0.35	80,500	
Grouting of foundation		lump sum	22,500	
				$ 518,850
Spillway				
Stripping	12,000 " "	0.65	7,800	
Quarry	260,000 " "	1.50	390,000	
Shaping	10,000 " "	2.50	25,000	
Concrete, weir	300 " "	80.00	24,000	
Reinforcing	18,000 lb	0.15	2,700	
Grouting		lump sum	7,500	
				$ 457,000
Outlet Works				
Excavation, trench	300 cu yd	5.00	1,500	
Concrete, structural	40 " "	150.00	6,000	
Concrete	320 " "	40.00	13,000	
Reinforcing bars	4,500 lb	0.20	900	
Miscellaneous steel	10,000 "	0.75	7,500	
Valves, etc.		lump sum	25,000	
				$ 53,900

(Continued on following page)

TABLE 1
ESTIMATED COSTS OF AGUA FRIA DAM AND RESERVOIR - SCHEME 1 (Continued)

Item	Quantity	Unit price	Item cost	Total cost
Reservoir				
Acquisition		lump sum	$515,000	
Clearing	500 ac	100.00	50,000	
Relocations		lump sum	120,000	
				$ 685,000
Subtotal, all items				$1,714,750
Contingencies, 15%				257,200
				$1,971,950
Engineering and administration, 12%				236,650
TOTAL				$2,208,600

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ESTIMATED ANNUAL COSTS

Operation, maintenance, & replacement	$ 12,500
Administration & general expense	7,500
TOTAL	$ 20,000

TABLE 2

ESTIMATED COSTS OF AGUA FRIA DAM AND RESERVOIR - SCHEME 2

Type of dam: Earthfill
Elevation of dam crest: 1,508 feet
Elevation of crest of spillway: 1,494 feet
Height of dam above streambed: 178 feet
Storage capacity: 50,000 acre-feet
Spillway discharge: 20,000 second-feet
Max. probable flood

Item	Quantity	Unit price	Item cost	Total cost
CAPITAL COSTS				
Dam				
Diversion and care of stream		lump sum	$ 10,000	
Stripping foundation area:				
Rock	6,000 cu yd	2.00	12,000	
Common	60,000 " "	0.60	36,000	
Stripping borrow areas	60,000 " "	0.25	15,000	
Excavation and haul:				
Random fill	80,000 " "	0.25	20,000	
Pervious	46,000 " "	0.25	11,500	
Filter	15,000 " "	3.50	52,500	
Rock spalls	15,000 " "	0.75	11,250	
Impervious, borrow	640,000 " "	0.45	288,000	
Placing and watering:				
Random fill	71,500 " "	0.35	25,000	
Filter and spalls	30,000 " "	0.20	6,000	
Pervious	48,000 " "	0.30	14,400	
Impervious	570,500 " "	0.35	199,600	
Grouting of Foundation		lump sum	22,500	
				$ 723,750
Spillway				
Stripping	16,900 " "	0.65	11,000	
Excavation	80,000 " "	0.80	64,000	
Concrete, structural	1,000 " "	100.00	100,000	
Backfill	1,500 " "	1.50	2,250	
Gunite	1,000 " "	50.00	50,000	
Reinforcing	150,000 lb	0.15	22,500	
Grouting and piling		lump sum	15,800	
				$ 265,550
Outlet Works				
Excavation, trench	300 cu yd	5.00	1,500	
Concrete, structural	40 " "	150.00	6,000	
Concrete	320 " "	40.00	13,000	
Reinforcing bars	4,500 lb	0.20	900	
Miscellaneous steel	10,000 "	0.75	7,500	
Valves, etc.		lump sum	25,000	
				$ 53,900

(Continued on following page)

TABLE 2

ESTIMATED COSTS OF AGUA FRIA DAM AND RESERVOIR - SCHEME 2 (Continued)

Item	Quantity	Unit price	Item cost	Total cost
Reservoir				
Acquisition		lump sum	$515,000	
Clearing	500 ac	100.00	50,000	
Relocations		lump sum	120,000	
				$ 685,000
Subtotal, all items				$1,728,200
Contingencies, 15%				259,200
				1,987,400
Engineering and administration, 12%				238,500
TOTAL				$2,225,900

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ESTIMATED ANNUAL COSTS

Operation, Maintenance, & replacement	$ 12,500
Administration & general expense	7,500
TOTAL	$ 20,000

Summary, Reservoir Operation Study and Project Yield

An operation study of the proposed Agua Fria reservoir was made for the 42-year period between 1921-22 and 1962-63 by using the estimated monthly runoffs as developed by the U. S. Corps of Engineers and monthly demand distribution as estimated by the department. This study period included most of the 20-year dry period from 1917 to 1937 as well as the commonly used 7-year dry period from 1928 to 1935. The study was based on the following criteria: (1) Limit reservoir drawdown to approximately 25 feet during the recreation season; (2) Release 1000 acre-feet annually on an irrigation schedule; (3) Double the preceding releases if the reservoir is full on April 1; (4) In addition to the above, release all natural stream flows occurring between May 1 and November 1. On the basis of these conditions a firm yield of 6,400 acre-feet per year was obtained.

An area-capacity curve of the proposed reservoir has been included as Figure 1 on the following page. An annual summary of the operation study is presented as Table 3 on the subsequent page.

Estimated Water Demands

As part of this investigation estimates were made of the probable economic demands for water from the proposed project. These demands are anticipated to develop in the Catheys Valley area, the Agua Fria-Mormon Bar vicinity, and in the Town of Mariposa. It is recognized that other localities such as White Rock, Oakvale, and Hornitos might be furnished a water supply from the proposed project; however, such inclusions do not appear to be financially feasible.

The projected water demands in acre-feet are shown by decades in the following tabulation:

1970	1980	1990	2000	2010	2020
710	4,800	6,400*	6,400*	6,400*	6,400*

*Limited by the available supply.

AREA AND CAPACITY CURVES- AGUA FRIA RESERVOIR

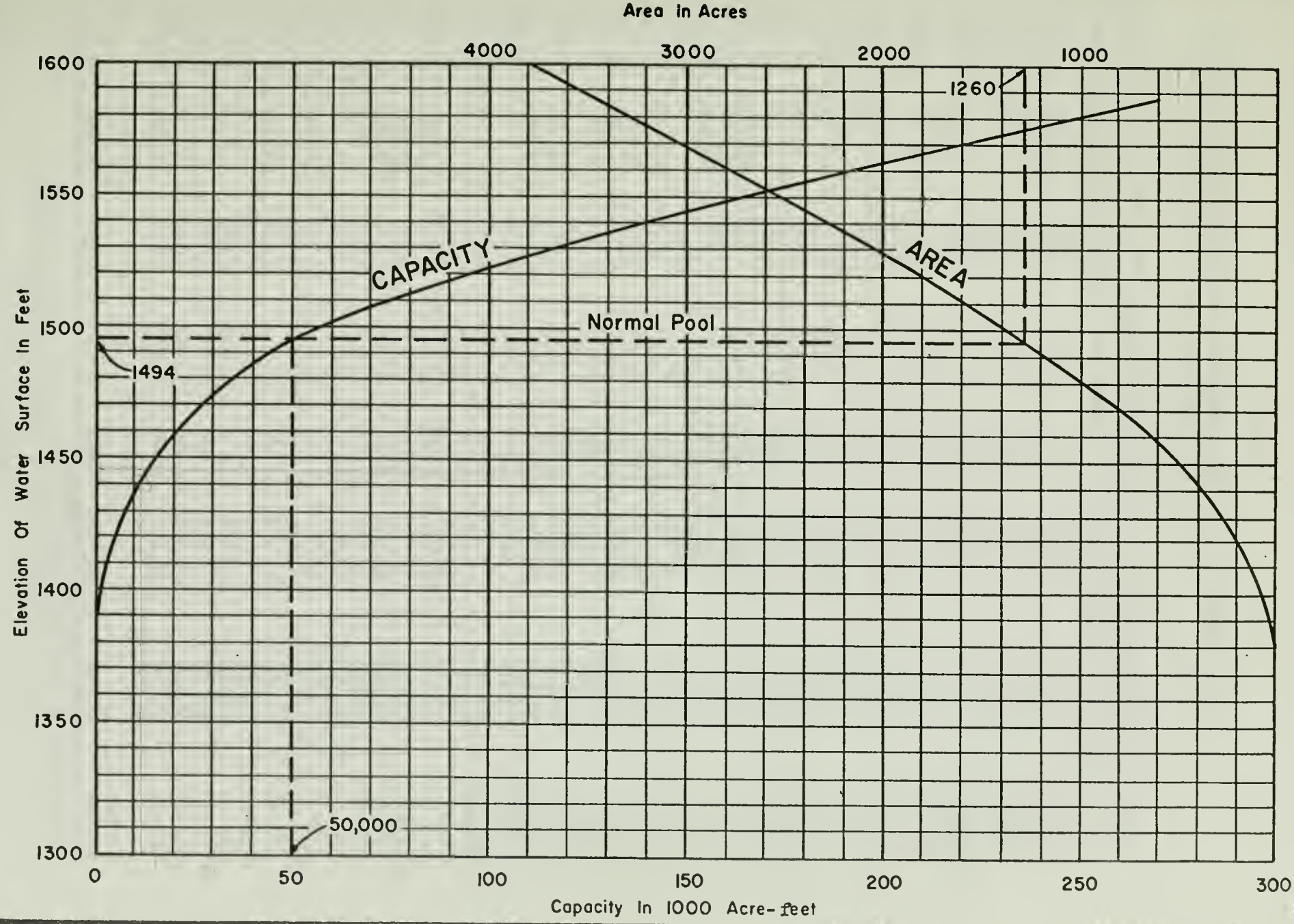


FIGURE I

TABLE 3

ANNUAL SUMMARY OF AGUA FRIA RESERVOIR OPERATION STUDY
(in acre-feet)

Water year	Storage at 1/ beginning of year	Runoff	Releases to stream	Project demand	Evaporation	Spill	Storage 2/ on July 1
1921-22	15,000	43,140	4,020	6,400	2,830	4,970	46,560
1922-23	39,920	30,190	3,600	6,400	2,480	17,710	46,560
1923-24	39,920	1,650	1,160	6,400	2,160	0	37,630
1924-25	31,850	12,890	2,040	6,400	2,370	0	39,800
1925-26	33,930	6,150	1,350	6,400	2,230	0	35,800
1926-27	30,100	27,360	2,300	6,400	2,690	5,390	46,780
1927-28	40,680	15,710	2,370	6,400	2,571	5,136	46,564
1928-29	39,913	3,130	1,680	6,400	2,211	0	38,570
1929-30	32,752	4,960	1,590	6,400	2,040	0	33,100
1930-31	27,682	1,470	1,110	6,400	1,680	0	25,100
1931-32	19,962	27,610	2,120	6,400	2,565	0	42,502
1932-33	36,487	3,850	2,120	6,400	2,120	0	35,540
1933-34	29,697	3,000	1,290	6,400	2,120	0	28,610
1934-35	22,787	23,350	2,980	6,400	2,530	0	40,160
1935-36	34,227	36,800	2,960	6,400	2,630	19,047	46,560
1936-37	39,900	36,320	3,280	6,400	2,590	24,010	46,600
1937-38	39,940	69,600	4,240	6,400	2,570	56,420	46,570
1938-39	39,910	8,170	1,590	6,400	2,480	0	43,620
1939-40	37,610	34,320	2,610	6,400	2,580	20,430	46,570
1940-41	39,910	56,530	4,320	6,400	2,520	43,290	46,570
1941-42	39,910	19,660	3,470	6,400	2,550	7,240	46,570
1942-43	39,910	39,730	3,940	6,400	2,520	26,870	46,570
1943-44	39,910	6,800	1,580	6,400	2,410	0	42,270
1944-45	36,320	28,250	3,500	6,400	2,600	12,160	46,570
1945-46	39,910	13,420	1,980	6,400	2,490	2,890	46,220
1946-47	39,570	3,640	1,250	6,400	2,210	0	39,190
1947-48	33,350	6,340	2,180	6,400	2,080	0	34,710
1948-49	29,030	7,380	1,230	6,400	2,010	0	32,340
1949-50	26,770	12,620	1,120	6,400	2,220	0	35,350
1950-51	29,650	37,090	2,160	6,400	2,410	15,860	46,570
1951-52	39,910	50,740	3,930	6.400	2,530	37,880	46,570
1952-53	39,910	22,240	3,460	6,400	2,540	9,840	46,570
1953-54	39,910	12,480	2,610	6,400	2,630	840	46,570
1954-55	39,910	7,830	2,190	6,400	2,340	0	42,790
1955-56	36,810	48,920	3,190	6,400	2,400	33,830	46,570
1956-57	39,910	4,880	2,770	6,400	2,480	0	41,120
1957-58	33,140	47,190	2,380	6,400	2,590	29,050	46,570
1958-59	39,910	5,380	1,290	6,400	2,350	0	41,170
1959-60	35,250	6,630	1,170	6,400	2,250	0	37,850
1960-61	32,060	1,580	1,060	6,400	1,770	0	29,860
1961-62	24,410	24,730	1,240	6,400	2,780	0	44,760
1962-63	38,720 39,910	28,405	3,900	6,400	2,590	14,325	46,570
42-year average	35,400	21,073	2,389	6,400	2,395	9,291	41,705

1/ Beginning of water year is October 1.
2/ Amount of water in storage early in summer recreation season.

Catheys Valley

It is anticipated that Catheys Valley would experience a diversified growth should water become available from the proposed Agua Fria Reservoir. A rapid development of rural homesites would occur in this scenic location of excellent climate. Ready accessibility to nearby valley cities by excellent State Highway 140 would stimulate business and professional people to locate homes here and commute to work. Homesites would be expected to average approximately two acres in size. About half of this land probably would be used as home orchard, vegetable garden, pasture for the children's saddle ponies, and as pasture for beef calves and sheep for home meat lockers.

An urban-type area would develop to serve local residents and tourists, with water requirements for domestic and commercial purposes added to that for public parks, school grounds, and fire protection.

Agricultural water demands from the canal would occur for about 200 acres of walnut orchards planted on the more favorable bottom-land soil areas. Also, sufficient irrigation water at low cost could be provided for about 500 acres of pasture for the period 1970 to 1990. After this time there would be an increased population growth which would cause a gradual change in land use from commercial pasture into rural homesite developments.

Buildup of demand in acre-feet per year is predicted to be as follows:

Year:	1970	1980	1990	2000	2010	2020
Treated water	450	1200	1900	2600	2600	2600
Untreated water	0	2200	2200	500	500	500
TOTAL	450	3400	4100	3100	3100	3100

Agua Fria - Mormon Bar

With the construction of the proposed Agua Fria Reservoir, a substantial increase in growth is foreseen for the Agua Fria-Mormon Bar basin area. Much of this development would be in the nature of rural homesites, occupied by retired people as well as by those employed locally. It is anticipated that these rural homesites would average approximately one acre in size, with about 20 percent of the total homesite area irrigated to fruit orchard and vegetable garden.

In addition, an urban community is expected to develop at Mormon Bar. Total population for this service area following completion of the Agua Fria Reservoir is expected to increase from the 1960 figure of 400 to 650 in 1970, 3,900 in year 2000, and 7,200 in 2020.

Buildup of water demand in acre-feet per year for this area as limited by the available water supply is predicted to be as follows:

Year:	1970	1980	1990	2000	2010	2020
Treated water	170	800	1200	1600	1600	1600

Town of Mariposa

The Town of Mariposa will be directly benefitted from the Agua Fria Reservoir. Department population projections reflect a steady increase from 730 people in 1960 to 1,200 in 1970, 6,600 in year 2000, and 12,000 in 2020. This development is dependent upon the availability of an assured supply of water, such as could be provided by the proposed Agua Fria Reservoir. The Town of Mariposa would continue to grow as the shopping, professional, and industrial center for the county. Here would live many of the construction people erecting homes, stores, and other buildings in the region. Companies and industries providing building

supplies, house furnishings, animal feeds, nursery and garden supplies, sports materials, recreation items, and other consumer goods or services would be located here and offer year around employment. All of this could result from the development of an assured dependable water supply and the attraction of Agua Fria Reservoir with its developed facilities for recreational activities. This would be the same type of growth which presently is occurring in other foothill counties.

All water requirements for the Town of Mariposa are described as urban although quantities were estimated separately according to three primary uses: domestic, public, and commercial. Indicated project water demands in acre-feet per year which follow are those in excess of the firm annual yield of Mariposa Reservoir on Stockton Creek, estimated at about 400 acre-feet per year:

Year:	1970	1980	1990	2000	2010	2020
Treated water	90	600	1100	1700	1700	1700

Water Supply Facilities

As part of this project feasibility study, preliminary designs were made for some of the water supply features of the proposed project and estimates of costs made for all features. A description of the proposed water supply facilities and the estimated costs of those facilities are presented in this section.

Description

The preliminary design of water supply facilities is shown on Plate 8, entitled "Initial Water Supply Facilities." This design was based on the following assumptions, criteria, and conditions:

(1) Pipeline to Catheys Valley would be sized to supply the ultimate demand for that area as limited by the available supply. On the basis of continuous 24-hour-per-day flow and minimum head, the pipeline would be capable of delivering the peak monthly demand quantity of 620 acre-feet. The higher peak daily demand rates would be supplied from the proposed Catheys Valley Reservoir. During early years up to 1990 deliveries could exceed an ultimate allocation of 3100 acre-feet.

(2) The open canal would be sized to carry the maximum flow as delivered by the full open pipeline under conditions of maximum head. The canal would initially be unlined. At some future time the seepage losses would become more costly and at that time the investment in lining would be made.

(3) The proposed terminal reservoir on Owens Creek near Catheys Valley would be sized to take advantage of the existing natural terrain. Its estimated capacity of 160 acre-feet would be in excess of that required to make up the short time peak demands. Due to the natural topography of the site, however, the excess capacity could be obtained at a negligible cost and provide a minimum seven-day supply at ultimate peak demand. This would provide insurance against emergency interruption of service from the main reservoir. An analysis of the operation of this reservoir including the inflows from Owens Creek would undoubtedly show that winter time demands for water in the Catheys Valley area could for many years be met from Owens Creek alone and that

this supplementary yield would be more than sufficient to offset yearly seepage and evaporation losses of the unlined reservoir.

(4) Intake pumps and treatment plants would be sized to a capacity sufficient to supply the expected 1980 peak daily demands based on a 24 hour per day operation. Plants would be outdoor type with covered clear wells. Peak hourly demands would be supplied partially from storage.

(5) Storage capacity for treated water would be sufficient to supply 50 percent of the average 1980 daily demand, or 1,000 gallons per minute fire flow for a period of two hours plus 50 percent of the domestic hourly demand rate, whichever were greater. The first requirement governs the sizing of storage facilities for both the Agua Fria and Catheys Valley service areas.

(6) Main distribution lines would be sized to carry a peak flow $2\frac{1}{2}$ times the daily average rate with a residual pressure of a minimum of 30 pounds per square inch (p.s.i.) or a fire flow of 1,000 gallons per minute plus 50 percent of the average domestic rate with a residual pressure of a minimum of 10 p.s.i., whichever would be greater. Demand rates for this purpose would be those expected in 1980.

The locations, diameters, and lengths of the main distribution lines as shown are for purposes of illustration and approximate cost estimation only. Pipe diameters and lengths as shown are adequate to support a scattered development of the design demand. Final location and sizing of the main distribution lines would depend, of course, on private development of the lands to be served.

(7) Water supply for the public recreation facilities would be obtained from the proposed Agua Fria treatment plant. Based on an estimated 1980 peak holiday use of 5,000 visitors and an average 30-gallon per-person per-day demand, the recreation area would require a maximum of 150,000 gallons per day. This amount accounts for eight percent of the initial capacity of the proposed Agua Fria intake structure, treatment plant, and storage facilities.

Estimated Costs

Preliminary designs of treatment plants and storage tanks were not accomplished; but for purposes of this report, sufficiently accurate estimates of capital and operating costs were obtained from estimates based on current costs of facilities of similar type and capacity.

Estimated costs of facilities other than those discussed above are based on the design layout as shown on Plate 8 and the assumptions and criteria as previously outlined. Estimates of capital costs are presented in Tables 4, 5A and 5B which follow.

TABLE 4

ESTIMATED CAPITAL COSTS OF INITIAL WATER SUPPLY FACILITIES

Feature	Quantity	Unit	Unit cost	Total cost
Agua Fria Treatment Plant Intake	-	L.S.	-	6,600
Agua Fria Treatment Plant	1,300	gpm	225.00	292,000
Agua Fria Treated Storage	630,000	gal.	0.045	28,500
Agua Fria-Mormon Bar-Mariposa Main	22,000	ft.	Avg. 6.00	132,000
Catheys Valley Pipeline	40,000	ft.	10.00	400,000
Catheys Valley Canal	10,000	ft.	2.50	25,000
Catheys Valley Reservoir	-	L.S.	-	24,000
Catheys Valley Treatment Plant Intake	-	L.S.	-	4,800
Catheys Valley Treatment Plant	1,200	gpm	225.00	270,000
Catheys Valley Treated Storage	525,000	gal.	0.045	23,600
Catheys Valley Distribution Mains	16,500	ft.	Avg. 6.00	99,000
		Subtotal		$ 1,305,500
		Less 8% Agua Fria intake, treatment, & storage facilities		26,200
				$ 1,279,300
		Contingencies, 15%		191,900
				$ 1,471,200
		Engineering & administration, 15%		220,700
				$ 1,691,900
		say $ 1,700,000		

TABLE 5A

ESTIMATED CAPITAL COSTS OF EXPANSION OF WATER SUPPLY FACILITIES IN 1980

Feature	Cost
Expansion of Agua Fria Treatment Plant to 1950 gpm capacity	$160,000
Expansion of Agua Fria Treated Storage to 1,000,000 gal. capacity	19,000
Expansion of Agua Fria Distribution Mains	25,000
Expansion of Catheys Valley Treatment Plant to 1800 gpm capacity	150,000
Expansion of Catheys Valley Treated Storage to 875,000 gal. capacity	17,500
Expansion of Catheys Valley Distribution Mains	25,000
Subtotal	$396,500
Contingencies, 15%	59,500
	$456,000
Engineering & administration, 15%	68,500
	$524,500
say $ 525,000	

TABLE 5B

ESTIMATED CAPITAL COSTS OF EXPANSION OF WATER SUPPLY FACILITIES IN 1990

Feature	Cost
Expansion of Agua Fria Treatment Plant to 2600 gpm capacity	$162,500
Expansion of Agua Fria Treated Storage to 1,450,000 gal. capacity	22,000
Expansion of Agua Fria Distribution Mains	37,500
Expansion of Catheys Valley Treatment Plant to 2250 gpm capacity	110,000
Expansion of Catheys Valley Treated Storage to 1,150,000 gal. capacity	15,000
Expansion of Catheys Valley Distribution Mains	28,000
Subtotal	$375,000
Contingencies, 15%	56,300
	$431,300
Engineering & administration, 15%	64,700
	$496,000
say $ 500,000	

Annual Costs

The costs of operation, maintenance, and replacement of the water treatment plants would depend on a number of variable factors such as the demand, the chemistry of the raw water supply, and the elevation of the water surfaces in the reservoirs and storage facilities. Operation and maintenance costs of the distribution systems depend on demand, number of service connections, elevations of delivery points, and other factors. For purposes of this report it is estimated that over a 50-year repayment period the operation, maintenance, and replacement costs would average out as follows:

Water treatment, storage, and distribution - - - $15.00 per acre-foot
Additional pumping charge for water to Mariposa - $ 8.50 per acre-foot
Catheys Valley pipeline and canal - - - - - - - - $7,500 per year
General expense - - - - - - - - - - - - - - - - - $10,000 per year

CHAPTER III. RECREATION

The words which follow, from the song of the ancient psalmist, are perhaps prophetic of benefits that the Agua Fria Project could offer Californians of present and future generations.

"He sendeth the springs into the valleys,
which run among the hills.
They give drink to every beast of the field:
the wild asses quench their thirst.
By them shall the fowls of the heaven have their habitation,
which sing among the branches.
He watereth the hills from his chambers;
the earth is satisfied with the fruit of thy works."

The California Legislature has recently mandated the planned development of recreation lands to provide an environment essential to the welfare of the State's increasing population. The construction of the proposed Agua Fria Project would serve to implement this legislative mandate and give reality to the vision of the ancient psalmist.

The visitor of the future to the Agua Fria Reservoir would find a world of oak and buckeye, of California bay and Digger pine. Here are native birds - towhees, juncos, yellow-bill magpies and circling red-tail hawks. Here, to the waters of the reservoir, would come water fowl, wild duck and geese, white egrets, and blue heron. The waters of the newly created reservoir would be the natural habitat of largemouth bass to challenge anglers. Catfish, blue gill, and green sunfish would also inhabit the shady coves and bays.

Beyond the shore areas, quail and dove would continue to nest. Large brush areas would remain to give deer and other game protected access to the shoreline. Camping facilities would accommodate both family and larger group-sized units. Complete facilities would be provided for the traditional water sports of boating, fishing, and swimming as well as for the newer skills of water skiing and scuba diving. The water temperatures would be pleasant and would accentuate the enjoyment of water sports.

The proposed Agua Fria Reservoir area possesses outstanding potential for the development of recreation facilities and affords an ideal setting for extensive recreation oriented suburban development. The proposed dam would be constructed at the downstream apex of a large valley containing 15 square miles of gently sloping terrain characterized by numerous ridges and small tributary streams. Between Mariposa Creek on the eastern edge of this valley and Agua Fria Creek on the western edge a long peninsula would extend through the proposed reservoir almost down to the proposed dam. The existence of this peninsula would further enhance the recreational potential by providing greater accessibility for shoreline recreation facilities.

Expected Recreation Use

Estimates of the expected recreation use of the proposed Agua Fria Reservoir area were determined by analyzing the statistics-of-use acquired by existing facilities, and then applying those statistics, by projection, to certain facts about the Agua Fria location. These facts may be summarized as follows: Agua Fria would be situated about midway

between the metropolitan areas of Los Angeles and San Francisco Bay; the location would provide an "above the fog, below the snow" winter season attractiveness, its proximity to Yosemite National Park would help ease the burden of that often crowded facility; and the area would be easily accessible to visitors.

Table 6 illustrates the anticipated recreation use of Agua Fria Reservoir in number of visitor-days per year that will be averaged in each decade between years 1970 and 2020.

TABLE 6

RECREATION USE BY DECADES IN VISITOR-DAYS
AT PROPOSED AGUA FRIA RESERVOIR

Decade ending	Annual use during mid-year of decade	Total use during decade
1980	350,000	3,500,000
1990	690,000	6,900,000
2000	1,140,000	11,400,000
2010	1,190,000	11,900,000
2020	1,240,000	12,400,000

Proposed Reservoir Clearing

The fisheries and wildlife enhancement potentials of the proposed reservoir would be hindered by the complete clearing of trees, brush and grass. The full recreation values and potentials can be realized by clearing a portion of the reservoir and leaving undisturbed plant communities in other parts of the reservoir basin. To provide

the maximum benefits for water-associated recreation, the following criteria were adopted:

(1) Around the periphery of the reservoir, those lands situated between an elevation of 1464 and 1494 feet would be completely cleared with the exception of bays, coves, and inlets cross-hatched on Figure 2.

(2) Below elevation of 1464 feet clearing would be accomplished as follows:

a. All brush and trees which would penetrate above an elevation of 1464 feet would be either removed or cut off at or below that elevation.

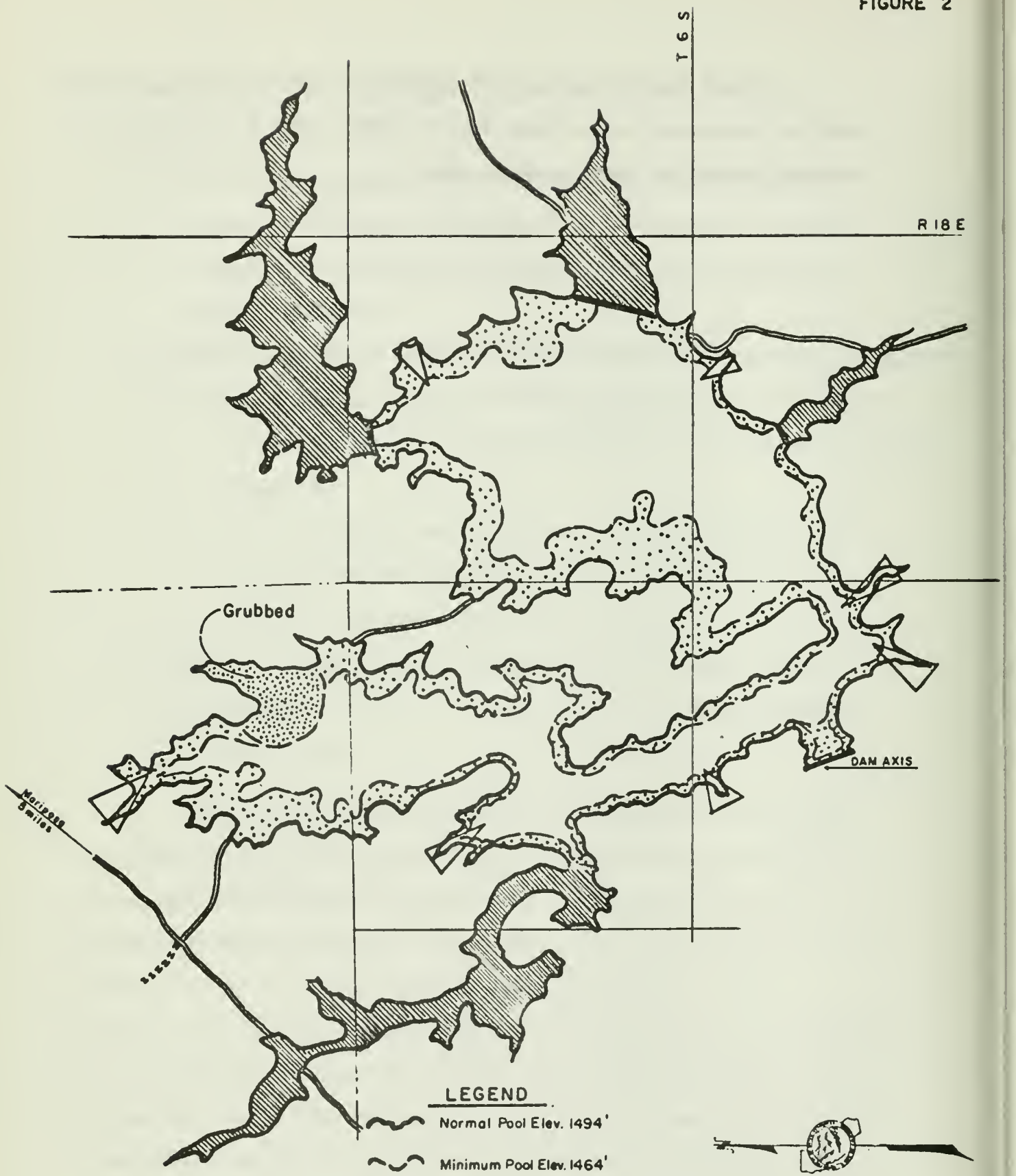
b. The area of the reservoir within a distance of 1000 feet of the intake to the treatment plant would be completely cleared and grubbed of all vegetation.

(3) Except as noted in 2b above, clearing would be done in such a manner as to leave duff and other organic material overlying the mineral soil.

These provisions would provide about 949 acres of open water for boating, fishing, and swimming, or about 72 percent of the water surface area at normal pool. Areas not to be cleared would provide additional fishery enhancement in the littoral zone. The expense of reservoir clearing would be held to a minimum while costs of water treatment would be virtually unchanged due to the fact that the unrestricted recreation activity at Agua Fria dictates the treatment processes. After the reservoir has been in existence for 3 or 4 years, water quality should be essentially the same as if complete clearing had been accomplished.

Brush lanes should be left standing in selected places, leading from the surrounding brush fields down to minimum pool to provide sheltered access for game to get to water.

FIGURE 2



STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
PROPOSED RESERVOIR CLEARANCE

AGUA FRIA RESERVOIR

SCALE 0 1000 2000 3000 4000 Feet

Development of Recreation Facilities

The surrounding lands of the proposed Agua Fria Reservoir are well suited for recreation development. The topography, vegetative cover, and proximity to the water's edge of the lands proposed for development are ideal.

Initial facilities are proposed to be developed in the Buckeye area at the northern end of the peninsula. There are numerous granite outcroppings in this area which would make it necessary to carefully plan and construct the facilities but which would give them an attractive setting. The proposed initial facilities are shown on Plate 10, entitled "A Plan for the Initial Development of Recreation Facilities," and the estimated costs of those facilities are presented in Table 7. The plan provides for roads, parking, boat ramp, campground, picnic area, swimming beach, sanitary facilities, and concession area designed to a capacity sufficient to service adequately the demand for the first ten years.

About 1980 the initial facilities would attain capacity use, and additional facilities would be needed. Plate 9, entitled "Land Use Plan," illustrates future development which could be located in two other areas -- the Bridgeport and Peninsula areas -- prior to the time that the total recreation potential would reach its developed capacity.

TABLE 7

ESTIMATED CAPITAL COST OF INITIAL RECREATION DEVELOPMENT
AT PROPOSED AGUA FRIA RESERVOIR

Item	Quantity	Unit price	Item cost	Total cost
Site Preparation				
Clear and Grub	34 acres	$ 250.00	$ 8,500	
Strip for Roads and Parking	7 acres	500.00	3,500	
				$ 12,000
Roads and Parking				
Construct new access road	1.1 miles	15,000.00	16,500	
Improve existing road	1,550 sq yd	1.00	1,550	
Construct campground roads and parking	3,900 sq yd	1.50	5,850	
Construct boat ramp parking	22,900 sq yd	1.50	34,350	
Construct picnic area roads and parking	4,700 sq yd	1.50	7,050	
Construct concession area roads and parking	3,000 sq yd	1.50	4,500	
Provide drainage		lump sum	10,650	
Provide signing		lump sum	1,200	
Provide barriers		lump sum	3,500	
				$ 85,150
Boat Launching Ramp				
Grade and shape		lump sum	6,500	
2 reinforced concrete lanes 15' x 300'	9,000 sq ft	1.50	13,500	
Soil cement 40' x 300'	12,000 sq ft	0.50	6,000	
				$ 26,000
Beach				
Clear and grub	1 acre	250.00	250	
Grade, shape, and sand	5,000 sq yd	1.50	7,500	
				$ 7,750
Campground	27 unit	300.00		$ 8,100
Picnic Area	200 unit	200.00		$ 40,000
		Sub Total		$ 179,000
		Contingencies, 10%		18,000
				$ 197,000
		Engineering & Administration, 10%		20,000
				$ 217,000

(Continued on following page)

TABLE 7 (Continued)

ESTIMATED CAPITAL COST OF INITIAL RECREATION DEVELOPMENT
AT PROPOSED AGUA FRIA RESERVOIR

Item	Quantity	Unit price	Item cost	Total cost
Water Supply				
Intake, treatment plant and storage facilities based on 8 percent of total			$ 26,200	
4" dia. A. C. pipe	4,000 lin. ft.	3.50	14,000	
Plumbing and fixtures		lump sum	1,800	
				$ 42,000
Sanitation				
Sanitary facilities and sewage disposal system complete				$ 105,000
Subtotal				147,000
Contingencies, 10%				14,700
				161,700
Engineering & administration, 10%				16,200
Subtotal for initial water supply and sanitation facilities				177,900
Subtotal for initial recreation development				217,000
TOTAL				$ 394,900

Alternative Proposals for Operation of Recreation Facilities

The annual recreation costs and revenues at Agua Fria Reservoir can be expected to differ notably depending upon the administration of the agency that operates the recreation at the reservoir. In California there are many publicly owned reservoirs operated for recreation; their methods of operation differ greatly. Approved ways of operating Agua Fria Reservoir are (1) as a state recreation area, (2) as a local-agency-operated recreation area, and (3) by leasing to a concessionaire.

The operation of the reservoir as a state recreation area would be similar to that at Folsom Lake State Recreation Area. State standards are high. The personnel and facilities necessary to meet state standards are expensive but provide a level of service that the public appears to appreciate.

Operation of the proposed Agua Fria Reservoir and its recreation facilities by the local water agency can be compared to the operation of Lake Gregory and its facilities by the Crest Forest Water District in San Bernardino County. The lake is about 90 surface-acres in extent. The recreation facilities include swimming beach, dance pavilion, and parking lot, as well as boat, paddle board, umbrella, and other play equipment for rent. All facilities, including refreshment stands, are owned and operated by the district, and recreation revenues are available for operation, maintenance, and renewal of the dam and reservoir.

It should be noted that, while profits are to be expected from this type of operation, they are not automatic. Managerial skill is essential, and the selection of a competent and experienced manager is a requisite for profitable development and operation.

Table 8 presents the estimated costs and revenues associated with this type of development at Agua Fria.

The third alternative mode of operation, that of leasing part or all of the recreation resource to a concessionaire, would involve the least cost to the local district, but relatively small revenue. This is the style of operation at Lake Berryessa, in Napa County. The rate of capital investment by concessionaires can be expected to be slow, and full development as a public attraction to be deferred. Both the net benefit to the public and the revenue to the owner are relatively small under the concession scheme.

TABLE 8

AGUA FRIA OPERATION BY A WATER DISTRICT

Decade ending year	Annual visitor days (Mid-year of decade)	Annual revenue @ $0.50/visitor (Mid-year of decade)	Annual operation and maintenance @ $0.37/visitor 1/ (Mid-year of decade)	Annual net income (Mid-year of decade)
1980	350,000	$ 175,000	$ 129,500	$ 49,500
1990	690,000	345,000	255,300	89,700
2000	1,140,000	570,000	421,800	148,200
2010	1,190,000	595,000	440,300	154,700
2020	1,240,000	620,000	458,800	161,200

1/ The cost per visitor-day was obtained from the Crest Forest County Water District, San Bernardino County, records of 1960, 1961, and 1962.

Future Expansion of Recreation Facilities

In order to provide assurances that the potential of the recreation areas could be adequately developed in the future, estimates have been developed of the type, cost, and time scheduling for future expansion of the recreation facilities. In this analysis it has been assumed that future expansion would be accomplished in two stages.

The first stage of expansion would occur about 1980 and would include additional camp and picnic sites, more parking facilities, additional rest rooms, an expansion of the swimming beach, and supplementary concessions. The cost of this work was estimated to be $248,000.

The second stage of expansion would be constructed about 1990 and would complete the full development of facilities to the ultimate capacity of lands proposed for public recreation. This stage would probably include the addition of another boat ramp and administration area in addition to more camping, picnicking, swimming, and parking facilities. Estimated cost of this final stage of expansion is $230,000.

In Chapter VII of this report the financing and recovery of these future costs are considered.

CHAPTER IV. FISH AND WILDLIFE

The material presented in this chapter is taken from an excellent, comprehensive report prepared by the Department of Fish and Game. The report is entitled "Fish and Wildlife in Relation to the Proposed Agua Fria Project." A limited number of copies of that report will be made available by the Department of Fish and Game.

Description of Existing Fishery

Although Mariposa Creek, Agua Fria Creek, and Buckeye Creek are intermittent streams with surface flow normally ceasing by August of each year, there is a fairly abundant fish population within the proposed reservoir area. This population is limited to Mariposa Creek. There are sufficient pools in this stream, even in late summer, to maintain a minor fishery.

Species seen in the proposed reservoir area include bluegill (Lepomis macrochirus), green sunfish (Lepomis cyanellus), largemouth bass (Micropterus salmoides), mosquito fish (Gambusia affinis), and suckers (Catostomus sp.). All fish seen were in good condition, with no external evidence of parasites or diseases. The largemouth bass were generally less than 12 inches in length, but a few approached 15 inches and would weigh almost 3 pounds. A few green sunfish had attained lengths of about 8 inches.

Although data sufficient to estimate the size of the total game fish population within the reservoir area are not available, an indication of abundance was gained by observing fish in one of the larger pools. This pool, located about 200 yards below the bridge in the Mariposa Creek arm of the reservoir, was about 90 feet long and 30 feet wide.

Maximum depth was approximately 4 feet, but the greater part of the pool was less than 2 feet deep. The water was clear, with few areas of poor visibility, such as weedbeds or overhanging rocks. Rough counts of the game fish present in this pool indicated there were about 12 largemouth bass, from 8 inches to 15 inches, and 60 to 80 green sunfish, from 4 to 6 inches. Golden shiners (Notemigonus crysoleucas) were seen in the creek above the reservoir area, and catfish (Ictalurus sp.) have been reported in the area.

Most of the lands riparian to Mariposa Creek in and below the proposed reservoir area are private lands which are fenced and posted against trespass. Angler access to the stream is thus quite restricted and angler use is light. There is, however, some angling use as evidenced by a few bait jars and leader packages seen during the survey. These jars and leader packages were quite weathered and had probably been deposited some months prior to the survey. It is assumed that the major part of the existing angler use on Mariposa Creek consists of landowners and their guests. This use probably occurs during the late spring and early summer before the onset of hot weather and low streamflows. The total annual use in this area, in and below the reservoir area, is about 200 angler-days.

Without water development the present land use and ownership patterns in this area are expected to remain similar to what presently exists. There may be some consolidation of the smaller holdings, but this should not cause any appreciable change in the basic land use patterns.

As our society becomes more affluent and has more leisure time, there will be a greater demand for angling in what are now considered

marginal angling waters. This demand will be spurred on by a continuation of the population expansion which we are presently undergoing.

With the continued upward trend in population there seems to be an inverse trend in the policies of landowners regarding trespass rights, particularly in relation to hunting and fishing access. Fewer and fewer landowners are willing to permit trespass on or over their lands for fishing. The increasing demand for fishing access is being thwarted by the decreasing area available for access.

In view of the above considerations, it is believed that future angling use on Mariposa Creek in and below the proposed reservoir area, and without water development, will be no greater than at present. Thus, future angling use without the Agua Fria Project would probably be about 200 angler-days per year.

Effects of Project on Fish

The major effect of construction of the Agua Fria Project on the existing fish populations would be to inundate the existing streams. Existing fish populations would then be presented with a lake type environment in which rapid population expansion would occur.

Construction of this project would allow storage of the natural flows of Mariposa, Agua Fria, and Buckeye Creeks. However, the effect of this project on the downstream fishery is expected to be slight. Releases from the dam would be at least sufficient to maintain the isolated pools and their resident fishes at the same level that now prevails.

In many years there would be no spill from Agua Fria Reservoir. Consequently, the winter and spring flow regimen below the damsite would

be drastically altered. The lack of winter flood flows would allow vegetation to become more firmly entrenched in the pools and on the banks. Establishment of vegetation on the banks and in the pools would help stabilize the channel and allow a more complex community of aquatic insects to develop which would provide a more complete utilization of the productivity potential of the stream. At the same time vegetative growth will somewhat reduce the area available to fish. For this reason the future angling-use potential of the stream below the damsite with the project is expected to remain close to its present potential.

Several characteristics of Agua Fria Reservoir indicate moderately high production of fish. These factors are discussed below:

(1) Reservoir Configuration. The proposed reservoir would have a highly irregular shoreline, with many small bays and peninsulas. The total shoreline length at normal pool elevation would be about 24 miles, as compared with a surface area of 1,260 acres. Such a high ratio of shoreline to surface area is generally indicative of relatively high aquatic production. Furthermore, the reservoir would be relatively shallow. At normal pool, over 40 percent (520 acres) of the reservoir would be less than 30 feet in depth. This characteristic would also indicate a favorable basic productivity level.

(2) Nutrient Supply. The reservoir site is in a watershed that lacks an abundant supply of nutrients. However, the sewage treatment plant for the Town of Mariposa discharges into Mariposa Creek a few miles above the reservoir. The sewage

receives primary treatment and percolates into the stream from ponds. The effluent totals about 148 acre-feet annually. It is believed that this effluent would continuously introduce a substantial quantity of nutrients into the Mariposa Creek arm of the reservoir, resulting in an appreciably higher level of aquatic production than might otherwise be expected.

(3) Reservoir Operation. The average annual drawdown of Agua Fria Reservoir would be about 10 feet. Relative to other California foothill reservoirs, this is considered to be a minor fluctuation. Fish production would be greater with stable water levels; however, it is believed that production would still be high with the presently contemplated operation schedule. Reproduction of largemouth bass and other game fishes should not be adversely affected by the rate of drawdown, which would be less than one-half foot per week.

It is concluded that Agua Fria Reservoir would produce a substantially greater poundage of fish each year than most other California reservoirs in the Sierra Nevada foothills, based on the above factors. It is estimated that the reservoir could support a standing crop of fishes of approximately 250 pounds per surface acre at normal pool elevation.

Assuming that the reservoir could support 250 pounds of game fish per acre, consideration must be given next to the size composition of this population to estimate yield to anglers. Part of the population would consist of fish too small to be of any value to most anglers. The remainder of the population would be of harvestable size. Reservoirs with topography, water quality, and operations well suited to warmwater

fisheries, and with well-balanced fish populations, usually have 75 percent of the weight of the total population in harvestable-sized fish. The harvestable population of Agua Fria Reservoir would thus approach 187 pounds of warmwater game fish per surface acre.

Under moderately heavy fishing pressure, a catch of one third to one half of the harvestable population can be expected each year. Since availability to the angler is partially dependent upon size and depth of the reservoir, a long term annual catch rate of one third of the harvestable size game fish, 62.5 pounds per acre per year, could be reasonably expected for this moderate-size reservoir.

The annual catch rate for the first 5 years or so after completion of the reservoir can be expected to exceed 62.5 pounds per acre. This period is expected to provide the maximum fish population during the lifetime of the reservoir, averaging at least 350 pounds of game fish per surface acre, with a corresponding potential yield of 87.5 pounds per acre per year. This is the period when a dramatic surge in fish populations produces remarkable angling for a few years, followed by a decline to moderate angling quality as nutrients, initially in the surface soils of the reservoir site, are consumed. Following the initial period of high productivity, the annual catch rate can be expected to decline gradually to about 62 pounds per acre per year.

The term "angler capacity" is defined as the total number of angling days that any given body of water will support annually with a satisfactory level of angling quality. In California, an average catch of approximately one pound of warmwater game fish per angler-day is considered to be an acceptable level of quality by most anglers..

The potential long term angler capacity of Agua Fria Reservoir is thus estimated to be 62.5 angler-days per acre per year (a catch of one pound per angler-day times 62.5 pounds potential yield). The total annual angler capacity would be 78,750 days (1260 acres times 62.5 angler-days per acre per year).

The minimum pool and operational schedule as proposed for Agua Fria Reservoir is sufficient to provide for considerable fisheries enhancement in Mariposa Creek. Conditions could be even further improved if the operational schedule were modified so that once in every 10-year period a drastic drawdown would occur. This drawdown should be to a minimum pool of 400 surface acres, containing about 12,000 acre-feet of water at a surface elevation of 1,442 feet. A drawdown such as this would force game fish and forage fish into a smaller area where they would be subjected to relatively severe environmental stress. Infrequent periods of stress can "pep up" a fishery so that productivity, catch rate, and yield will increase in the following years.

The only planned outlet at the dam is at elevation 1,438 feet. Thus, if the reservoir were to be chemically treated to remove rough fish after impoundment, there would be about 12,000 acre-feet of water to be treated. Cost of this treatment is currently $2.16 per acre-foot, and total cost of each treatment program would be $26,000. If a streambed level outlet were provided so that the reservoir could be emptied, in the event of a rough fish build-up, costs of treatment would be greatly reduced. Restocking following treatment should be according to the initial reservoir stocking plan unless experience subsequent to the initial reservoir stocking dictates otherwise.

Complete removal of all vegetation within the maximum pool of any reservoir seems to be an established practice. The reasons given for removal of vegetation range from "it looks better" to "elimination of boating hazards" and "elimination of bad taste and foul odors." These advantages, however, are questionable. Determination of the esthetic qualities of a cleared reservoir is wholly subjective with the individual viewer. Boating hazards can be eliminated by removing only those trees that extend above the minimum pool elevation, while taste and odor problems associated with the original vegetation in the reservoir area are usually nonexistent after the first two or three years of project operation.

There are distinctly beneficial effects of not clearing a reservoir site completely however. Three of these are:

(1) An extension of the initial period of high biological productivity.

(2) Concentration of the game fish close to the vegetation, i.e. around bushes and trees, making them more available to the angler.

(3) Reduction in the costs of reservoir clearing.

Effects (1) and (2) have not been evaluated specifically, although they were considered in connection with projections of potential angling capacity of Agua Fria Reservoir. Benefit (3) can be closely estimated in terms of dollars saved, as shown in the following paragraph.

The cost of complete clearing of Agua Fria Reservoir is estimated to be about $126,000. A clearing plan designed to increase the fishery value of the reservoir, maintain or improve other recreational

values, and provide a $76,000 savings (60 percent) in costs of clearing has been prepared. This plan is detailed in the preceding chapter of this report. Generally the plan calls for complete clearing of shrubs and trees on about 260 acres of the reservoir area, 400 acres partially cleared, and 600 acres uncleared. The above plan provides, at maximum pool, about 950 acres of unobstructed water surface for high-speed boating and water skiing while retaining over 200 acres in a "sheltered zone" classification. A speed limit of 5 miles per hour in these "sheltered zones" would reduce boating hazards, minimize erosion, reduce water skier-fisherman antagonism, and retain the integrity of the sheltered classification.

Description of Existing Wildlife

Important mammals observed in the project area were: California mule deer, Audubon cottontail, black-tailed jackrabbit (Lepus californicus), racoon (Procyon lotor), bobcat (Lynx rufus), coyote (Canis latrans), and ground squirrel (Citellus beecheyi). Upland game birds observed in the area were: California quail, mourning dove (Zenaidura macroura), and wood duck (Aix sponsa).

Table 9 shows the acreages of each habitat type in the project area and gives estimates of the numbers of quail and cottontails dependent upon that habitat and the number of days each habitat type was used by mule deer. It is estimated that the area that would be inundated by Agua Fria Reservoir and the proposed recreation areas presently support 1,290 California quail, 172 cottontails and 3,415 deer-days of use.

TABLE 9

ACREAGES OF HABITAT TYPES AND WILDLIFE POPULATION

Habitat type	Acres	Number of quail	Deer days-of-use	Number of cottontail
		Reservoir Area		
Oak	452	230	1,040	30
Oak-grass-brush	220	150	400	0
Brush	445	580	1,070	90
Grass	136	0	110	0
Rock	7	0	5	2
Totals	1,260	960	2,625	122
		Public Recreation Area		
Oak	180	90	320	10
Brush	183	240	440	40
Grass	37	0	30	0
Totals	400	330	790	50

The proposed reservoir site and recreation area are located on private lands. Hunting at present is light and is limited to the landowners and their guests. Limited numbers of deer are taken from the reservoir site during the hunting season. The quail population supports a slightly higher hunting pressure. An estimated 300 hunter-days are spent annually hunting quail and deer in the project area.

Livestock grazing is the principal use of lands within the project area. It is anticipated that this land use will continue in the absence of a water development project, and that present levels of wildlife populations will remain constant in the foreseeable future. The

present hunting use of 300 days annually would also continue if the waters of Mariposa and Agua Fria Creeks are not developed.

Effect of Project on Wildlife

Inundation or clearing of wildlife habitat at a reservoir site results in displacement of the wildlife dependent upon that habitat. The displaced wildlife are forced to occupy available habitat adjacent to the reservoir. Almost invariably, the adjacent habitat is already supporting wildlife to its maximum capacity. The ultimate result is loss of wildlife. For some wildlife species, losses exceed the number of animals displaced because of range deterioration.

It is anticipated that the Agua Fria Project would result in the loss of 1,290 quail, 172 cottontails, and 3,415 deer-days of use because of elimination of their habitat. In addition, urban development predicted in the reservoir service area would probably adversely affect wildlife. No estimates of the specific effects of such development are available.

Mitigation of wildlife losses, as proposed in the following section of this report, would provide greater hunting opportunity than now exists. It is estimated that measures for the mitigation of wildlife losses would permit 1,000 hunter-days of annual use in the area. Thus, an increase of approximately 700 hunter-days per year could be attributed to the project.

Proposed Preservation Features

A number of wildlife species will be displaced with the construction of the proposed Agua Fria Project. The losses can best be mitigated by a habitat improvement program in areas adjacent to the reservoir site. Most species displaced will be compensated for on lands selected for quail

preservation. Mitigation of wildlife losses can best be accomplished by purchasing additional lands which lend themselves to management for optimum wildlife capacities. The project sponsor should purchase and manage the following parcels of land to reach this goal: that portion of the $SE\frac{1}{4}$ $SE\frac{1}{4}$ of Section 11 above normal pool elevation; the $S\frac{1}{2}$ $SW\frac{1}{4}$, and $SW\frac{1}{4}$ $SE\frac{1}{4}$ of Section 12 above normal pool elevation; $NW\frac{1}{4}$ $NE\frac{1}{4}$ and the $N\frac{1}{2}$ $NW\frac{1}{4}$ of Section 13; and the $N\frac{1}{2}$ $NE\frac{1}{4}$ and $SW\frac{1}{4}$ $NE\frac{1}{4}$ of Section 14 above normal pool elevation in Township 6 South, Range 18 East, Mt. Diablo Base and Meridian.

This land above normal pool elevation is estimated at 320 acres. Approximately 20 acres are included within the proposed take line along the shore line. Thus, 300 acres of additional land are necessary for wildlife preservation in the described area. The existing quail population, from which proposed preservation acreage was calculated, was determined by projection of figures pertaining to similar vegetative types within the reservoir site. An estimated 245 quail exist in the area in which preservation measures are proposed. With proper habitat management an additional 1,255 quail can be added to the population (Table 10).

TABLE 10

WILDLIFE MANAGEMENT AREA AND
POTENTIAL WILDLIFE HABITAT DEVELOPMENT

Vegetation type	Treatment	Acres	Existing quail pop.	Potential quail pop.
Brush	Crush, clear, strip, pile burn, build firetrail, etc.	49	65	250
Oak	Partially clear, strip, and pile brush	24	10	30
Oak-grass-brush	Crush, clear, and pile brush	239	170	1,200
Grass	Provide cover (brush piles)	8	0	20
Total		320	245	1,500*

*Total quail population increase 1,255

Initial development, operation, and maintenance costs for the area proposed for wildlife preservation are as follows:

300 acres of land purchased @ $300 per acre average	$ 90,000
$2\frac{1}{2}$ miles of livestock fencing @ $1,000 per mile	2,500
Improving existing wildlife habitat by crushing and burning brush and trees, making brush piles, stripping and building fire trails at $25 per acre on 320 acres	8,000
Development of water by spring improvement, installation of guzzlers or sumps at two sites @ $700 each	1,400
Total initial development costs	$101,900
Total annual maintenance costs	$ 2,000

Provisions for retaining standing brush and tree travel lanes and sheltered zones would provide cover for wildlife moving to and from the reservoir for water.

Recommendations

To provide for optimum enhancement of fishery resources in Agua Fria Reservoir, the following recommendations of the Department of Fish and Game have been adopted to the extent they are consistent with other project purposes:

1. Reservoir storage should not be reduced below 25,000 acre-feet.
2. The rate of reduction of water surface level should not exceed one-half foot per week during the months of April, May and June.
3. The reservoir basin should not be completely cleared prior to impoundment. A vegetation clearing plan shown in Figure 2, calling for complete clearance of 260 acres, partial clearance of about 400 acres, and nondisturbance of 600 acres is recommended for fishery enhancement.

4. Consideration should be given to a reservoir drawdown to a surface elevation of 1,442 feet every 10 years. It is believed this measure would rejuvenate the warmwater fish population.

5. The reservoir should be stocked with 100 fingerling largemouth bass per actual surface acre during the first year of impoundment. Additional species should be added when and if needed, as recommended by the Department of Fish and Game.

6. The water outlet at elevation 1,438 feet should be screened to prevent loss of adult fish through the distribution system.

To provide for compensation of wildlife losses that would be attributed to the Agua Fria Project, it is recommended that:

1. The project sponsor should purchase and develop for wildlife production the following parcels of land in Township 6 South, Range 18 East M.D.B.&M.

   (a) That portion of the $SE\frac{1}{4}$ $SE\frac{1}{4}$ of Section 11 above normal pool elevation.

   (b) That portion of the $S\frac{1}{2}$ $SW\frac{1}{4}$ and $SW\frac{1}{4}$ $SE\frac{1}{4}$ of Section 12 above normal pool elevation.

   (c) The $NW\frac{1}{4}$ $NE\frac{1}{4}$ and the $N\frac{1}{2}$ $NW\frac{1}{4}$ of Section 13.

   (d) The $N\frac{1}{2}$ $NE\frac{1}{4}$ and $SW\frac{1}{4}$ $NE\frac{1}{4}$ of Section 14 above normal pool elevation.

2. Wildlife preservation lands should be fenced to control livestock grazing.

3. The project sponsor should provide the Department of Fish and Game with approximately $2,000 annually for maintenance of recommended wildlife management lands.

4. Public hunting should be permitted on wildlife management lands and in all project areas, when compatible with other uses.

CHAPTER V. LEGAL CONSIDERATIONS

Based upon a limited amount of research conducted during this study it appears that legal considerations would allow the development of the proposed Agua Fria Project.

Water Rights Considerations

In the development of the proposed Agua Fria Project consideration has been given to prior vested rights. Studies of reservoir operations have been made on the assumption that none of the small flows which normally occur between the first of May and the last of October would be available for project purposes. These studies have also included releases to Mariposa Creek in addition to the firm yield proposed for use within proposed project service areas. A summary of water rights in the Mariposa Creek basin, as of May 5, 1964, considered during this study is shown in Table 11.

Water rights for the proposed Agua Fria Project would be based on Applications 17130 and 20715. These applications are held by the California Water Commission as trustee, and were filed by the Department of Water Resources.

Procedures Required to Implement Project

The Mariposa County Water Agency was created during the 1959 session of the State Legislature by Chapter 2036, Statutes of 1959. The agency has filed a request for a preliminary determination of eligibility under the Davis-Grunsky Act and has been granted an extension of time to file a formal application for state financial assistance.

TABLE 11

APPLICATIONS TO APPROPRIATE WATER FROM DEADMAN CREEK WATERSHED AND MARIPOSA CREEK WATERSHED

Application number	Date filed	Present owner	Source	Point of diversion 1/ Section	Twp	Range	Amount CFS or GPD 2/	Amount Acre feet	Period
5702	9/29/27	James F. Chamberlain	North Slough (Mariposa Creek)	SE SE 17	8S	14E	1 C		3/ 1-10/ 1
5703	9/29/27	James F. Chamberlain	North Slough (Mariposa Creek)	SE SW 16	8S	14E	3 C		3/ 1-10/ 1
6160	1/14/29	Elinor E. Haun	Mariposa Creek	NE SE 23	8S	13E	.038 C		4/ 1-10/ 1
6807	9/27/30	El Nido Irrigation District	Deadman Creek	SE SW 26	8S	14E	3.8 C		11/ 1- 4/15
8238	2/11/35	El Nido Irrigation District	Duck Slough	SW NW 11	8S	14E		5,066	11/ 1- 4/15
10797	4/11/40	Michael Rahilly, Jr.	North Slough (Mariposa Creek)	SW NE 24	8S	13E	1.25 C		2/ 1- 5/ 1
13218	7/ 8/49	Peter Rahilly, Jr.	Snake Slough	NE NE 18	8S	14E	3 C		2/ 1-11/ 1
15701	1/25/54	Mariposa Public Utility District	Stockton Creek	SE NE 14	5S	18E	0.54 C	 180	1/ 1-12/31 10/ 1- 5/31
16831	1/16/56	Harvey L. & Nola L. Bonnell	Unnamed Creek	SE SE 25	5S	18E	12413 G	18	4/ 1-12/31
16991	4/ 6/56	William S., Jr. & Evelyn E. Fiske	Buckeye Creek	NE SW 22	5S	18E		25.5	10/15- 5/15
16992	4/ 6/56	Harry H. Bumguardner	McBride Creek	SE SE 16	5S	18E		11	10/ 1- 5/31
16992	4/ 6/56	Harry H. Bumguardner	McBride Creek	SW NE 21	5S	18E		4	10/ 1- 5/31
17075	5/ 4/56	G. A. & Ann S. Prinsen, & Leonard Fisher	Unnamed Creek	NE NW 17	5S	18E	0.091 C	 14.4	3/ 1-11/ 1 1/ 1-12/31
17095	5/18/56	Gertrude L. Irwin	Unnamed Creek	NW SW 12	6S	18E		5.3	11/ 1- 5/ 1
17130	6/12/56	California Water Commission	Mariposa Creek	15	6S	18E		15,000	1/ 1-12/31

TABLE 11

APPLICATIONS TO APPROPRIATE WATER FROM DEADMAN CREEK WATERSHED AND MARIPOSA CREEK WATERSHED (Continued)

Application number	Date filed	Present owner	Source	Point of diversion 1/ Section	Twp	Range	Amount CFS or GPD 2/	Amount Acre feet	Period
17324	10/15/56	Frank Long	Unnamed Spring	SE NE 21	5S	18E	1650 G		1/ 1-12/31
17472	2/20/57	Phil Rauch	Unnamed Creek	SW NE 26	6S	18E		9.4	10/ 1- 4/30
17649	6/11/57	Horace Meyer	Unnamed Creek	SE SW 07	5S	18E		5	10/ 1- 4/30
17775	8/16/57	James J. Uhle, Trustee	Deadman Creek	NW SE 29	8S	15E		73.68	1/ 1-12/31
17866	10/30/57	Byron J. & Lavelle B. Hartman	Unnamed Gulch	SW SE 11	6S	18E	2.2		11/ 1- 4/30
18218	7/18/58	Luther E. Bagwell	Unnamed Stream	SW NE 09	6S	18E		17	9/ 1- 5/15
18774	6/ 8/59	El Nido Irrigation District	Duck Slough	SW NW 11	8S	14E		5,000	11/ 1- 4/15
19004	9/28/59	Clifford P. & Margaret Royce	Unnamed Stream	NE NE 20	5S	18E		20	11/ 1- 7/ 1
19020	10/ 6/59	William R. Hull & Dorothy D. Carr	McBride Gulch	SE NE 25	5S	18E		5	11/ 1- 5/ 1
19360	4/18/60	Melvin C. & Lillian M. Rushton	Spring Gulch	NE SE 36	5S	18E	0.13 C		5/ 1-10/15
20088	4/17/61	Delbert C. & A. Lorrell Butler	Unnamed Spring	SE NW 30	5S	19E	3600 G		1/ 1-12/31
20246	6/ 5/61	Leslie Reininghaus	Duck Slough from	SW NE 25	8S	12E	3 C		4/ 1- 6/ 1
20246	6/ 5/61	Leslie Reininghaus	Duck Slough to	SE NE 25	8S	12E	3 C		
20715	4/ 9/62	California Water Commission	Mariposa Creek	NE 15	6S	18E	20 C	50,000	1/ 1-12/31
21172	3/ 1/63	Phil Rauch	Unnamed Creek	NW SE 24	6S	18E		2.5	10/ 1- 5/ 1
21172	3/ 1/63	Phil Rauch	Unnamed Creek	SE NW 23	6S	18E		1.5	10/ 1- 5/31
21173	3/ 1/63	Phil Rauch	Unnamed Creek	NE NE 23	6S	18E		160	11/ 1- 5/ 1
21365	6/ 2/63	Arthur Roach	Mono Gulch	SW SE 35	4S	18E		3	11/ 1- 5/31
21410	7/29/63	C. A. & Marion E. Laughlin	China Gulch	NE NE 07	6S	18E		40	10/ 1- 5/31

1/ All descriptions of points of diversion are referenced to Mount Diablo Base and Meridian.
2/ C - Cubic feet per second. G - Gallons per day.

The Davis-Grunsky Act (Sections 12880-12891.1 of the Water Code) authorizes state financial assistance in the form of loans to cities, counties, districts, and other political subdivisions of the State for the construction of local water projects, and grants for a portion of the costs of such projects properly allocated to recreation and fish and wildlife functions. The $1,750,000,000 California Water Resources Development Bond Act ratified in 1960 by the citizens of California included a sum of $130,000,000 earmarked specifically for state assistance under the Davis-Grunsky Act. During 1961, and again in 1963, the Legislature amended the Act in order to liberalize state assistance to local projects.

The Davis-Grunsky Act is administered by the Department of Water Resources in concurrence with the California Water Commission. Administrative regulations are contained in the California Administrative Code, Sections 400 through 437. The department and commission have adopted joint Statements of Policies for Administration of the Davis-Grunsky Act.

The Agua Fria Project takes into consideration local economic growth and development. Construction of some of the project features would be deferred until such time as they are needed. The method of financing proposed in this report includes state assistance for the initial project features and the first stage expansion of the water supply system which is needed approximately 10 years after the project becomes operative. This method of financing obligates funds at the outset from the Davis-Grunsky program for construction of expanded facilities in about year 1980. The terms of the Davis-Grunsky Act do not expressly authorize nor preclude such a financing proposal.

The legislature may wish to give express guidance with regard to this proposal because future projects financed under the Davis-Grunsky Act which involve staged construction over a period of years could be affected. An intent of the legislature that Davis-Grunsky loans would be available for the initial costs of projects only, with future expansions of these projects being financed with Davis-Grunsky loans at the time the expansions would be required, does not clearly appear. In the absence of guidance in the law there is a question with respect to the propriety of the proposed method of financing. This is because the urgency of the future expansion, in relation to other projects, and the reasonable inability of the local agency to finance in the future from other sources, cannot be demonstrated at the time financial commitment by the State is proposed.

CHAPTER VI. ECONOMIC JUSTIFICATION

Water development projects are considered to be economically justified if estimated total benefits exceed total economic costs, if each separable purpose provides benefits at least equal to its costs and if there is no more economical means of accomplishing the same purpose. Benefits represent the advantages or net gains to beneficiaries from receiving project water or other project services. Only primary or direct benefits from the Agua Fria Project are assigned monetary values in this report. The stimulation of economic activity made possible by the proposed project is expected to result in substantial indirect gains to the entire county.

Project Benefits

The primary concept of the Agua Fria Project as developed in this report is that of forming an outstanding recreation area. There are several distinct and important types of benefits, however, which would result from construction of the project. These include water supply or conservation benefits as well as the recreation and fishery enhancement benefits. The water conservation benefits will result from urban, rural homesite, and agricultural uses. The estimated benefits from all project purposes are described below.

Water Conservation

Water supply or conservation benefits would accrue to a variety of water users, ranging from urban consumers in the town of Mariposa to domestic usage developed throughout the project service area and to commercial agriculture in Catheys Valley.

Urban. Stimulated by economic activity resulting from the proposed Agua Fria Project, substantial future growth of the town of Mariposa is anticipated. Estimates indicate an increase in population from 730 in 1960 to 1,200 in 1970; 3,000 in 1980; 4,800 in 1990; and to 6,600 in year 2000. With this growth in population, business and commercial establishments, schools, and industries, there will be a corresponding increase in water requirements. By 1970 the need for urban water will exceed the present available supplies. These additional requirements could be satisfied by water pumped from the Agua Fria Reservoir. It has been assumed that future development around the lower fringes of Mariposa and in the areas between Mariposa and Mormon Bar would be served from Agua Fria. It would also be possible and feasible to wholesale treated water to the existing supplier either instead of or in addition to the preceding.

Two other locations of urban-type developments are foreseen as population and economic activity expand throughout the project area. One would serve Catheys Valley while the other would serve the Mormon Bar-Reservoir vicinity. Although neither development would approach in importance that of the town of Mariposa, which will continue as the shopping and commercial center for the county, each would depend upon the project for satisfaction of water requirements.

Benefits for urban water are measured under the concept of vendibility, limited by the least costly alternative. This is the maximum average amount that users would be willing to pay rather than receive no project water and still not exceed the cost of any alternatives available to them. With reference to the Agua Fria

study area, there appears to be no other source of urban water supply which could be developed and marketed at a price less than vendibility.

Analyses of urban water prices have been made for foothill areas of several other counties. Residents of Mariposa County and other similar localities have also been questioned concerning prices which they would be willing to pay for a dependable water supply of satisfactory quality. From these studies it has been concluded that $130 per acre-foot is a reasonable value to assign to benefits for treated urban water delivered to the individual connection. In terms of average use, this amounts to about $8.00 a month to the individual connection.

Rural Domestic. Both the reservoir basin area and Catheys Valley are ideally adapted for rural homesites, with scenic attractiveness, rolling tree-covered knolls, excellent climate, and good accessibility. Accordingly, a steady development of rural homesites could be anticipated as soon as water would become available from the Agua Fria Reservoir. Population projections for the two areas show a combined increase from approximately 700 in 1960, to 1,120 in 1970; 2,900 in 1980; 4,700 in 1990; and 6,500 in 2000.

Homesites in the Mormon Bar-Reservoir area are expected to average about one acre in size. In addition to domestic water requirements, supplemental irrigation is planned for about 20 percent of this acreage for home fruit orchards, vegetable gardens, and small "hobby" pastures. Most of these homesites would be built by retired people and those employed locally.

Catheys Valley would witness a somewhat different type of rural development. For the most part, business and professional people would

locate here and commute to work in Merced, Mariposa, and other towns. Homesites are anticipated to average about two acres in size, with half of this acreage devoted to home orchards, gardens, and "hobby" pastures for children's saddle ponies and beef calves for home meat lockers. Water used for domestic purposes in rural homesites is assigned the same benefit as that for urban use, $130 per acre-foot for treated water. An analysis of urban and irrigation uses reveals a benefit value of $50 per acre-foot for supplemental rural homesite usage.

Commercial Agriculture. Topography and soils within the project service area are not, in the main, favorably adapted to growing agricultural crops for the market. It is anticipated that in Catheys Valley, however, some 200 acres of walnut and other nut orchards would be planted on the better bottom-land soils. Sufficient irrigation water at low cost would be available during the period from 1970 to 1990 to encourage planting about 500 acres of pasture. Subsequent to 1990 a transition would occur from commercial pasture to rural homesites.

Irrigation benefits, measured as the return to land and water from growing the crops, have been computed as $26 per acre-foot of water for the orchard, and $9 per acre-foot for the pasture.

Summary. Calculated on a present worth basis, the benefits accruing to each of the water conservation functions over the 50-year period of analysis are estimated to be as follows: urban - $3,376,000; rural domestic - $3,876,000; commercial agriculture - $442,000. Total water supply benefits are estimated to be $7,694,000.

Recreation

The Agua Fria Reservoir site is considered to be well adapted to the development of water-based recreation activities. The topography, climate, accessibility, location, and type and extent of vegetative ground cover enhance the attractiveness of the site for the many recreation activities that are envisioned.

The "California Public Outdoor Recreation Plan, Part II," indicates that California's population will double during the period 1958 to 1980 and the recreation demand per capita will increase by a factor of 1.5, thereby producing a three-fold increase in statewide recreation demand. This report also indicated that 60 percent of all recreation use in California during 1958 centered about water. It further indicated that in 1958 there was a 35 percent deficiency in space for reservoir swimming and related shoreline activities and a 50 percent deficiency in space for boating. In view of these critical shortages of space for reservoir recreation, the Agua Fria Project would provide an important contribution in meeting the needs for water-associated recreation.

Recreation benefits attributable to the project have been developed from a consideration of the predicted recreation use and from studies which measure the dollar value to the average individual user. By applying the department's method of estimating recreation benefits, a unit value of $1.20 per user-day was obtained. Calculated for the 50-year study period, 1970-2020, this results in a total present-worth benefit value of $17,061,000.

Fish Enhancement

Development of the Agua Fria Reservoir would provide a favorable environment for fish enhancement. There is presently a small amount of angling in the intermittent streams in the area, probably by riparian landowners and their guests.

The Departments of Fish and Game and Parks and Recreation have jointly estimated the fishery enhancement and increase in angling days which would result from the proposed reservoir. An increase of 120,000 angling days per year are projected for the first decade, followed by 87,500 angling days annually thereafter.

The unit benefit for angling is the same as that for recreation, $1.20 per user-day. This produces an estimated total present-worth value for fish enhancement of $2,607,000 for the 1970-2020 period of analysis.

Summary of Project Benefits

Project benefits, based on the present worth of estimated benefits which would accrue during a 50-year period of analysis, would total $27,362,000. These would include $17,061,000 of recreation benefits, $2,607,000 of fishery benefits, and $7,694,000 of water conservation benefits. Water conservation benefits would include $3,026,000 to Catheys Valley for urban, rural domestic, and agricultural water use; $2,604,000 to the town of Mariposa for urban water use; and $2,064,000 to the Agua Fria-Mormon Bar area for urban and rural domestic water use.

A summary of the project benefits is tabulated in Table 12 on the following page.

TABLE 12

SUMMARY OF AGUA FRIA PROJECT BENEFITS

Project Purpose	Project Benefits on Basis of Present Worth					
	1970-80	1980-90	1990-2000	2000-10	2010-20	Total for 50-year Period
A. Water Conservation						
1. Urban	$ 514,000	$ 794,000	$ 874,000	$ 712,000	$ 482,000	$ 3,376,000 1/
2. Rural Domestic	712,000	984,000	948,000	735,000	497,000	3,876,000 2/
3. Commercial Agricultural	54,000	198,000	134,000	33,000	23,000	442,000 3/
					Subtotal	$ 7,694,000
B. Recreation	2,466,000	4,065,000	4,771,000	3,376,000	2,383,000	17,061,000
C. Fish Enhancement	1,184,000	583,000	394,000	266,000	180,000	2,607,000
					TOTAL	$27,362,000

1/ Catheys Valley - - - - $ 408,000
Agua Fria-Mormon Bar - 364,000
Town of Mariposa - - - 2,604,000
Total $3,376,000

2/ Catheys Valley - - - - $2,176,000
Agua Fria-Mormon Bar - 1,700,000
Total $3,876,000

3/ Catheys Valley

Associated Project Advantages

Only direct tangible benefits have been taken into consideration in determining the economic justification of the Agua Fria Project. Other advantages, such as listed below, are expected to accrue to the entire county as a result of the stimulation of economic activity made possible by the proposed project:

1. Impetus to businesses and industries of many kinds resulting from constructing and furnishing new homes, stores, recreation concessions, and other buildings.
2. Purchasing activity of many new home owners and families, a large proportion of whom would bring in new spending capital from outside.
3. Increased requirements for supplies of many types for home orchards, gardens, pastures, livestock, irrigation systems, fences, etc.
4. Expansion of permanent year-round jobs to provide needed supplies and services for the newcomers.
5. Increased net value of land as improvements would be made, enhancing the tax base for the county.

It is not anticipated that a dramatic surge would take place in realizing these associated project advantages, but rather that a steady substantial growth would occur. All of this is contingent upon the realization of the Agua Fria Project, with the development of recreation facilities and the provision of dependable water supplies.

Costs

Estimates were made of the economic costs of the proposed multiple-purpose Agua Fria Project to determine whether the project would be economically justified. Estimates were also made of the economic costs of alternative methods of accomplishing project purposes and of the separable economic costs of each project purpose included in the multiple-purpose project. These estimates of alternative and separable costs were necessary to properly allocate costs to project purposes and determine the economic justification of each project purpose. These estimates of alternative, separable, and total costs are presented in this chapter.

Alternative Costs

The alternative cost for a project purpose within a multiple-purpose project is the total economic cost of the least costly alternative project which would accomplish the same purpose. In studies of alternative methods of accomplishing the purposes of the proposed Agua Fria Project, it has been found that no other site would be more economical for development. The alternative single-purpose projects are, therefore, based on the development of the same site as that for the multiple-purpose project.

The alternative cost to provide an identical water conservation benefit consists of the following:

Capital cost of 17,000 acre-foot reservoir to provide firm annual yield of 6,400 acre-feet	$1,650,000
Capital cost of initial water supply facilities	1,700,000
Present worth of future expansions of water supply facilities	583,000
Present worth of annual and operating costs:	
Water supply facilities	1,717,000
Dam and reservoir	215,000
Wildlife preservation features	43,000
Total	$5,908,000

The alternative cost to provide an identical recreation benefit consists of the following:

Capital cost of 40,000 acre-foot reservoir	$2,100,000
Capital cost of initial recreation facilities . . .	395,000
Present worth of future expansions of recreation facilities	273,000
Present worth of annual and operating costs:	
Recreation facilities	5,968,000
Dam and reservoir	430,000
Wildlife preservation features	43,000
Total	$9,209,000

The alternative cost to provide an identical fishery benefit consists of the following:

Capital cost of 40,000 acre-foot reservoir	$2,100,000
Capital cost of initial fish stocking	8,000
Present worth of annual and operating costs:	
Dam and reservoir	430,000
Wildlife preservation features	43,000
Total	$2,581,000

Separable Costs

The separable cost for each project purpose is the difference between the cost of the multiple-purpose project and the cost of the project with that purpose omitted. The separable cost for the fish enhancement purpose would be only the $8,000 cost of initial fish stocking. It is the only feature which could be eliminated if fish enhancement were excluded as a project purpose.

The separable cost for water conservation would be as follows:

Reduction of reservoir size to 40,000 acre-feet	$ 228,000
Present worth of capital costs, water supply facilities	2,283,000
Present worth of annual and operating costs, water supply facilities	1,717,000
Total	$4,228,000

The separable cost for recreation would be as follows:

Present worth of capital costs, recreation facilities	$ 668,000
Present worth of annual and operation costs, recreation facilities	5,968,000
Total	$6,636,000

Total Project Costs

The total project costs include all the following capital and operating costs for the multiple-purpose project:

Capital costs, dam and reservoir	$2,328,000
Capital cost of initial recreation facilities	395,000
Capital cost of initial water supply facilities	1,700,000 1/
Capital cost of initial fish stocking	8,000
Present worth of future expansions of recreation facilities	273,000
Present worth of future expansions of water supply facilities	583,000 2/
Present worth of all annual and operating costs, dam and reservoir	430,000
Present worth of annual and operating costs, recreation facilities	5,968,000
Present worth of annual and operating costs, water supply facilities	1,717,000 3/
Present worth of operation of preservation area	43,000
Total	$13,445,000

1/ Catheys Valley portion would be $1,120,000
2/ Catheys Valley portion would be $266,000
3/ Catheys Valley portion would be $760,000

Economic Justification

The total benefits of $27,362,000 exceed the total costs of $13,445,000 in the ratio of 2.04 to 1. Each project purpose provides benefits in excess of its cost, and there is no more economical means of accomplishing the project purposes. The proposed project is therefore found to be economically justified.

CHAPTER VII. FINANCIAL FEASIBILITY

A project is considered financially feasible if a reasonable showing can be made that: (1) sufficient capital will be authorized and available to finance construction of the project to completion; (2) customers are able and willing to pay the reimbursable costs for the project services and products; and (3) estimated revenue to be derived during the prescribed repayment period will be sufficient to recover the reimbursable project costs.

Cost Allocation

An allocation of costs among project purposes was made by the separable costs-remaining benefits method. The separable costs-remaining benefits method distributes costs among project purposes by identifying separable costs and allocating joint costs or joint savings in proportion to each purpose's remaining benefits. In the preceding chapter estimates of project benefits and costs were presented along with estimates of alternative and separable costs of project purposes. The allocation of costs to project purposes is shown in Table 13.

Financing of the Project

In the financing of the Agua Fria Project it was assumed that assistance would be requested from the State through provisions of the Davis-Grunsky Act. The Act provides for "... financial assistance to public agencies for the construction of water projects to meet local requirements in which there is a statewide interest by making grants or loans, or both ...."

TABLE 13

ALLOCATION OF COSTS OF AGUA FRIA PROJECT
(Thousands)

	Item	Recreation	Water Conservation	Fish Enhancement	Total
1.	Benefits	$ 17,061	$ 7,694	$ 2,607	$ 27,362
2.	Alternative costs	9,209	5,908	2,581	17,698
3.	Justifiable costs	9,209	5,908	2,581	17,698
4.	Separable costs	6,636	4,228	8	10,872
	a. Capital	668	2,511	8	3,187
	b. O. M. & R.	5,968	1,717	0	7,685
5.	Remaining justifiable costs	2,573	1,680	2,573	6,826
5a.	Percent distribution	37.7%	24.6%	37.7%	100%
6.	Remaining joint costs	970	633	970	2,573
	a. Capital	792	516	792	2,100
	b. O. M. & R.	178	117	178	473
7.	Total allocation	7,606	4,861	978	13,445
	a. Capital	1,460	3,027	800	5,287
	b. O. M. & R.	6,146	1,834	178	8,158
8.	Less cost of onshore facilities	668	-	-	668
9.	Justified grant for recreation and fish enhancement	792	-	800	1,592
10.	Grant for initial water supply and sanitation facilities				178
11.	Total justified grant				1,770

Davis-Grunsky Grants

Grants may be made for fish enhancement, recreation, and initial water supply and sanitary facilities which are needed for public recreation use.

Fish Enhancement. A grant may be made for the part of the construction costs of the proposed project properly allocated to fish enhancement, provided that such grant shall not exceed 50 percent of the construction cost of the project. A grant of $800,000 may be made for costs allocated to this purpose.

Recreation. A grant may be made for the cost of construction of the dam and reservoir properly allocated to recreation. The grant is limited to a maximum of 50 percent of the dam and reservoir costs. A grant of $792,000 may be made for costs allocated to this purpose.

The combined total of the fish enhancement and recreation grants is less than the permitted maximum of 75 percent of the project construction costs.

Water Supply and Sanitary Facilities. A grant may be made for the cost of initial water supply and sanitary facilities needed for public recreation use at the dam and reservoir. The initial water supply and sanitary facilities grant would amount to $178,000 which is less than the permitted maximum of 25 percent of the combined recreation and fish enhancement grants.

Summary. The allowable grants estimated to be available to the Agua Fria Project from the Davis-Grunsky Act total $1,770,000 including fish enhancement $800,000, recreation $792,000, and initial water supply and sanitary facilities $178,000.

Davis-Grunsky Loans

Construction costs of the project in excess of the grants indicated above could be financed by Davis-Grunsky loans. Such loans could total $3,186,000 including $490,000 required to complete the initial construction costs allocated to the recreation function. This latter amount would, therefore, have to be repaid by recreation fees. The balance of the loan, $2,696,000, would complete the initial construction and the first expansion of the water supply facilities.

Methods of Repayment

Three methods of repayment of the Davis-Grunsky loan are planned: recreation-user fees, water tolls, and ad valorem taxes. These methods are based upon the premise that those who benefit most directly should pay most of the costs.

Recreation-User Fees

An allocation of the costs of the proposed project resulted in a capital allocation of $1,460,000 to the recreation purpose. The allowable grant for recreation amounts to $792,000. The $490,000 difference between the recreation cost and the recreation grant less the amount of the grant for the initial water supply and sanitary facilities can, under departmental policy as approved by the California Water Commission, be recovered from fees charged to users of the recreation facilities.

Many types of facilities are planned to assist in the enjoyment of the reservoir. Based on an operation by the agency and on previously estimated costs and projections of use, a charge of 50 cents per visitor would be more than sufficient to amortize the debt, pay the cost of

operation, maintenance, and replacement, and expand the facilities as future demand may require. Such a charge would probably be consistent with the policy of the State in the administration of the Davis-Grunsky Act because the proposed operation of the reservoir would result in greater recreation use than other projects in this part of the State have had.

Water Tolls

A system of water tolls or charges is suggested, to be paid by those receiving water from the Agua Fria Project. The tolls have been developed after analysis of rates presently being paid in the Mariposa-Catheys Valley area, as well as in a number of similar locations in other foothill counties, and which the users have stated are reasonable. All tolls, except commercial agriculture, are for a dependable supply of treated water of satisfactory quality delivered to the proximity of the individual connection.

Urban. Domestic water tolls would be initially $8 per month flat rate and would gradually be reduced to $2.50 per month as shown on Table 15. With an average use of 0.75 acre-foot annually per connection this results in an initial charge of $128 per acre-foot. Initial commercial water tolls would be $16 per month flat rate, or $192 per year. Based upon an average of 1.5 acre-feet annually per connection the initial charge would be $128 per acre-foot. Domestic or commercial users requiring water supplies in excess of the quantities indicated would be able to purchase additional water on a metered basis for $30 per acre-foot.

Rural Homesite. Water supply for rural homesites would have two primary functions: domestic and supplemental homesite usage. Domestic water for house use would carry the same toll as urban domestic. Supplemental homesite water requirements for orchard, pasture, garden, etc., over 0.75 acre-foot annually would be metered and carry an initial charge of $30 per acre-foot.

Commercial Agriculture. Irrigation water requirements for commercial agriculture would not be large. Tolls were based upon untreated water at canalside in Catheys Valley. The 200 acres of walnut orchard would use 500 acre-feet per year at an initial charge of $10 per acre-foot. Water for irrigated pasture, 1,700 acre-feet annually during 1970-1990, would have an initial charge of $3.00 per acre-foot. The marketing of surplus water during the build-up period would assist the project's financial situation since incremental operational costs will be minor.

Ad Valorem Taxes

Revenues from taxes for repayment of the Agua Fria Project could be obtained under the authority of the agency and would amount to only a small portion of total project revenues during the 50-year period of project analysis. These revenues from taxes would provide a source of funds during the early years which would be an important contribution to the successful operation of the project. The proposed taxes would be a ten-cent countywide tax and an additional forty-cent tax on the property within the immediate project zone. These taxes would be reduced as shown on Table 15.

The project service area is shown on Plate 11, entitled "Proposed Project Zone." Water supplies would be available within the proposed service zone, and the zone would receive a major portion of the associated project advantages described in Chapter VI.

Repayment Analysis

A year-by-year analysis of the repayment of reimbursable costs of the Agua Fria Project is summarized in Table 15 bound near the end of this report. These costs include a loan under the Davis-Grunsky Act and future loans from other sources as well as the annual operation, maintenance, and replacement costs. The analysis includes two types of revenues: ad valorem taxes and those obtained from water tolls charged by the Mariposa County Water Agency to water customers of the project. The revenues from these sources would repay the costs as shown. During the development period no payment was made on capital costs. The annual interest payments would begin in 1971 together with amortization of the accumulated deferred interest. Accumulated deferred interest would be repaid during the 10-year development period. Debt service would continue over the remainder of the 50-year repayment period with all costs repaid by the year 2015.

As revenues increase through growth of domestic water use, water tolls would be reduced as indicated in Table 15. The total initial project costs of $4,956,000 include $68,000 to be incurred in 1979 and $457,000 incurred in 1980 to cover the estimated costs of the first expansion of water supply facilities. The final expansion of the water supply facilities is expected to be needed about 1990. The financing of the final stage would be obtained from regular sources available to the

agency. Table 15 indicates repayment of that loan at an assumed interest rate of four percent.

The financial analysis included in this report contains many assumptions as to matters which are in the province of the directors of the Mariposa County Water Agency. It is believed, however, that the assumptions employed are sufficiently representative to demonstrate that the suggested financial program is feasible and would remain so with reasonable variation in the assumptions.

Summary of Financial Feasibility

The Agua Fria Project is financially feasible. Provision of Davis-Grunsky grants in the total amount of $1,770,000 and Davis-Grunsky loans totaling $3,186,000 would provide adequate financing for the Agua Fria Project. Reimbursable costs assigned to the recreation function would be repaid by user fees. Reimbursable costs allocated to water conservation would be repaid by water tolls and taxes at rates which are believed reasonable and which should encourage growth of the project area.

CHAPTER VIII. STATE FUNDS

The Mariposa County Water Agency has indicated a desire to construct the proposed Agua Fria Project through state financial assistance under the Davis-Grunsky Act. An estimate has been made of the time schedule of funds which would be required for this project to assist in the planning and scheduling of the disbursement of state funds for local projects. The design and construction costs estimated in other chapters of this report have been broken down in this chapter into the year or years in which the costs probably would be incurred.

Estimated Schedule of Requirements

Assuming that the project proceeded essentially as outlined in this report, and barring unforeseen circumstances which would delay its progress, it is estimated that the final designs of the dam, spillway, outlet works, relocation features, reservoir, and intake structure would be completed in 1966. Construction could commence on some of these features in the spring of 1967.

The estimated project construction schedule and corresponding funding requirements are shown in Table 14 on the following page.

TABLE 14

ESTIMATED SCHEDULE OF REQUIREMENTS FOR FUNDS
AGUA FRIA PROJECT

(in dollars)

Year	Required for payment of	Yearly Funds Required
1965	(Design and administrative work in process)	
1966	Design of dam, spillway, outlet works, reservoir relocations, and intake structure	$ 239,000
1967	Construction of dam, spillway, etc., and provision of wildlife preservation area	1,120,000
1968	Completion of construction of dam, spillway, etc.	969,000
	Design of water supply facilities	221,000
1969	Construction of water supply facilities	1,479,000
1970 1/	Design and construction of recreation facilities	395,000
1971	Cost of initial fish stocking	8,000
1979	Design of expansion of water supply and distribution facilities	68,000
1980	Construction of expanded facilities	457,000
	TOTAL	$4,956,000

1/ Providing the reservoir storage is adequate.

CHAPTER IX. SUMMARY AND RECOMMENDATIONS

The Department of Water Resources, at the direction of the State Legislature, conducted a feasibility study of the proposed Agua Fria Project. An evaluation of the effect of the project on fish and wildlife was conducted by the Department of Fish and Game under an interagency agreement as part of the study. An evaluation of the recreation potentials of the project by the Department of Parks and Recreation, Division of Beaches and Parks, under a similar agreement, was also included in the study.

The feasibility of the proposed project was studied from the physical, legal, and economic viewpoints. The studies were designed to answer the following questions:

Are there any existing physical conditions which would prohibit or limit the construction of the project as proposed?

Are there any legal implications which would prohibit or place any limitations on the project as proposed?

What work would be required to build the project, and how much would it cost?

What benefits would be derived from the project and how would they compare with the costs?

Who would pay the costs? If money were to be borrowed, how would it be repaid?

Summary

The Mariposa County Water Agency was created in 1959 for purposes of conservation and development of the water resources of the county. The

agency is a dual function of the Mariposa County Board of Supervisors and of the officers and employees of the county.

In its dual responsibility the county government is faced with complex problems. The economy of the county has been quite static for many years. It has been based on a very few industries that show limited promise of expansion in the future. Most of the young people, therefore, find it necessary to move to the cities to find their opportunities. Some sections of the county, like the Agua Fria Project area, have much to offer in the way of scenery, climate, and accessibility, and although there has been a lot of interest shown by retired people and prospective commuters in moving into some of those areas, not many have done so. Lack of water has been a primary cause of their hesitation. Wells are expensive to drill and ground water supplies are not dependable in quantity or quality.

The county government, synonymously the Mariposa County Water Agency, looks upon this proposed Agua Fria Project as perhaps an answer to several of its problems. Much would be accomplished for the county by the creation of an attractive reservoir with adequate recreation lands and facilities combined with the development of new, dependable water supplies and facilities to deliver that water to (1) planned rural homesite areas, (2) selected agricultural land of high potential, and (3) the town of Mariposa. It would provide the needed supplemental source of water supply to the town of Mariposa and a dependable supply of water to some residents of Catheys Valley whose pumps are at times running dry. The project would attract new residents and broaden the narrow tax base, and it should help retain more of the existing young

residents by providing some opportunities at home. The construction of the project and of new homes would vitalize the economy of the area, and the increasing influx of new residents and recreationists should keep it nourished. The efforts of the county leaders therefore centered more and more on the Agua Fria Project, and this investigation and report resulted therefrom.

The development of a dependable supplemental water supply for Catheys Valley has been included in the Agua Fria Project because of its importance in boosting the general economy of the county. The studies have shown that the direct benefits to Catheys Valley would exceed the costs; however, the reimbursable costs of the project are greatly increased by including the extensive facilities necessary to service the Catheys Valley area. This report therefore includes sufficient information so that the agency could analyze the project without inclusion of the Catheys Valley features.

The major feature of the Agua Fria Project would consist of a dam, 178 feet in height, on Mariposa Creek below its confluence with Agua Fria Creek and lying in the northeast quarter of Section 15, Township 6 South, Range 18 East (Mount Diablo Base and Meridian). The proposed dam would provide a reservoir containing 50,000 acre-feet of water with approximately 1,260 acres of surface and 24 miles of shoreline. The reservoir drawdown would be limited to approximately 25 feet during the recreation season to develop near maximum potential for recreation and fish enhancement. On this basis the reservoir would provide a firm annual yield of 6,400 acre-feet. At minimum pool it would have a surface area of about 800 acres. Average annual drawdown would be approximately 10 feet and corresponding surface area would be 1,060 acres.

On the Buckeye Creek arm of the reservoir an intake structure and a water treatment plant would be constructed. A water supply line would also be installed approximately along the route of the existing "Old Highway" to Mormon Bar and the town of Mariposa. Pumping stations and storage facilities would be an integral part of that supply line and would be located in conformance with the development of the private lands to be planned through this area.

An outlet works would be provided through the right abutment of the damsite to allow releases to Mariposa Creek or diversion through a pipeline and an unlined canal to a terminal reservoir in Catheys Valley.

The Catheys Valley Reservoir would be the forebay for a water treatment plant that would supply the distribution system to service that area.

The various water supply features of the proposed project are designed to provide for the utilization of the reservoir yield in a way that would return the highest and earliest benefits. There would be surplus water available until nearly the year 2000, most of which would be used in Catheys Valley for commercial irrigation of pasture.

Geologic exploration was accomplished in the fall of 1963 to determine the adequacy of existing physical conditions for the various features of the proposed project. Core drilling of the damsite and auger drilling of prospective borrow areas comprised the major portion of this exploration. No unusual or unexpected physical conditions were encountered or discovered that would limit or preclude the construction of the project as described. No special treatments due to local conditions are anticipated. A more quantitative investigation during the

final design phase would determine the wisdom of the tentative decision that the dam would be an earthfill type.

Acquisition of lands and relocation of roads and utilities for the proposed dam, reservoir, and public recreation areas should be relatively uncomplicated. A partial clearing of the reservoir lands is proposed.

There are two peninsulas jutting into the proposed reservoir from the north. Both of these would be acquired and set aside for public recreation use. There is a total of about 950 acres of land in the two areas. These areas would support the development of facilities sufficient to provide for a demand that would be expected in the year 2020 -- approximately 1.25 million visitor-days per year. The initial facilities, including roads, parking areas, boat ramp, picnic areas, campgrounds, swimming beach, concessions, etc., would be located on the north end of the long peninsula between arms of the reservoir formed by Buckeye and Mariposa Creeks. The initial facilities would be sufficient to handle the expected recreation demand until the year 1980, i.e. 470,000 visitor-days per year.

The expected warm-water fishery that would be created by the proposed reservoir can conservatively be described as above average. The reservoir clearing program as recommended in this report is designed to benefit both fish and fisherman. It would also be beneficial to wildlife; however, additional measures are recommended to prevent wildlife losses.

From the legal viewpoint, the proposed project appears to be entirely feasible. There seem to be no legal implications which would limit or preclude construction of the project. The provision of releases

to Mariposa Creek are expected to be sufficient to assure that downstream water users would not be adversely affected.

Financing of the project would be accomplished through state loans and grants, with the grant portions intended to cover most of the costs incurred to provide statewide benefits. The loan portion would cover the remainder of the costs and would be repaid by a combination of water tolls, recreation-user fees, and county and local taxes. Costs would be borne in proportion to benefits received insofar as it is possible to allocate the costs and measure the benefits.

The overall project has a ratio of benefits to costs of about 2 to 1. Repayment capacity would be sufficient to fully amortize the loan within the allowable time. The project is, therefore, found to be economically justified and financially feasible.

Recommendations

Based on studies conducted during this investigation, it is recommended that:

1. The Mariposa County Water Agency seek legislative guidance as to the proposed method for financing the Agua Fria Project.
2. The agency take immediate steps to obtain water rights necessary for the project.
3. Immediate consideration be given to initiating final planning and design of the project.

4. Consideration be given to the formation of local committees for purposes of studying and making recommendations on property assessments, operation of recreation area, building restrictions and zoning, public information, and other local functions that will be instrumental in obtaining the results for which the project is designed.

5. The agency give careful consideration to the desirability of inclusion of water service to Catheys Valley as an initial feature of the project.

6. The special project zone be formed in the immediate future under provisions of the Mariposa County Water Agency Act, Chapter 2036, Statutes of 1959.

7. The agency build the project as soon as possible and retain ownership and control of its various features in order to vitalize the economic development of Mariposa County to the greatest extent possible.

APPENDIX A

LEGISLATIVE AUTHORIZATION OF AGUA FRIA PROJECT FEASIBILITY STUDY

CHAPTER 1854, STATUTES OF 1963

An act authorizing the Department of Water Resources to complete feasibility studies of, and prepare a feasibility report on, the proposed Agua Fria Project and making an appropriation therefor, declaring the urgency thereof, to take effect immediately.

(Approved by Governor July 18, 1963. Filed with Secretary of State July 19, 1963)

CHAPTER 1854, STATUTES OF 1963

The people of the State of California do enact as follows:

SECTION 1. The Department of Water Resources is hereby authorized to complete feasibility studies of, and to prepare a feasibility report on, the proposed Agua Fria Project on Mariposa Creek in the County of Mariposa. The project feasibility report that is prepared pursuant to this authorization shall be delivered to the Legislature by the department by March 1, 1964.

SECTION 2. There is hereby appropriated from the California Water Fund the sum of seventy-eight thousand dollars ($78,000) to the Department of Water Resources for expenditure for the purpose of carrying out the objectives of Section 1 of this act; provided, that no expenditure of such sum shall be made by the department unless the Mariposa County Water Agency agrees in writing with the department by July 20, 1963, to repay to the department one-seventh of the cost of such feasibility report, with such repayment to be made upon terms satisfactory to the department, after a project is constructed on the basis of such project feasibility report. Any and all money received by the department from such repayment by the agency shall be deposited in the State Treasury to the credit of the California Water Fund.

SECTION 3. This act is an urgency measure necessary for the immediate preservation of the public peace, health, or safety within the meaning of Article IV of the Constitution and shall go into immediate effect. The facts constituting such necessity are:

The proposed Agua Fria Project is urgently needed to stimulate the economic development of Mariposa County and to provide a satisfactory domestic water supply. In order that the feasibility studies of the proposed project may be accomplished as soon as possible and that a feasibility report on the proposed project may be delivered to the Legislature at the 1964 Legislative Session, foundation drilling at the damsite of the proposed project must be accomplished during the summer of 1963. It is, therefore, necessary that this bill become effective immediately to provide immediate specific authority and funds for such studies and report.

APPENDIX B

CONTRACT

BETWEEN CALIFORNIA DEPARTMENT OF WATER RESOURCES AND MARIPOSA COUNTY WATER AGENCY CONCERNING FEASIBILITY STUDIES OF ACUA FRIA PROJECT

CONTRACT
BETWEEN CALIFORNIA DEPARTMENT OF WATER RESOURCES
AND MARIPOSA COUNTY WATER AGENCY
CONCERNING FEASIBILITY STUDIES OF AGUA FRIA PROJECT

THIS CONTRACT, entered into this 16th day of July , 1963 by and between the Department of Water Resources of the State of California, hereinafter referred to as the "Department," and the Mariposa County Water Agency, hereinafter referred to as the "Agency," a political subdivision of the State of California, duly organized, existing and acting pursuant to the laws thereof, with its principal place of business in California,

WITNESSETH, That:

WHEREAS, Senate Bill 1180, passed by the Legislature at the 1963 Regular Session, would authorize the Department to complete feasibility studies of, and to prepare a feasibility report on, the proposed Agua Fria Project on Mariposa Creek in the County of Mariposa in view of the statewide benefits that would be derived from such project; and

WHEREAS, said bill would appropriate from the General Fund the sum of seventy-eight thousand dollars ($78,000) to the Department for completion of such studies and preparation of such feasibility report with the condition that no expenditure of said sum shall be made by the Department unless the Agency agrees in writing with the Department by July 20, 1963, to repay to the Department, upon terms satisfactory to the Department, one-seventh (1/7) of the cost of such feasibility report after a project is constructed on the basis thereof; and

WHEREAS, the Agency is desirous of having such feasibility studies and report made by the Department and is therefore willing to enter into a written agreement with the Department as contemplated by said

bill to enable the Department to utilize said appropriation for such studies and report;

NOW, THEREFORE, it is mutually agreed as follows:

1. The Department agrees to make and complete feasibility studies of the proposed Agua Fria Project on Mariposa Creek in the County of Mariposa and to prepare a feasibility report on said project after Senate Bill 1180 becomes operative law, to the extent funds are available therefor.

2. As soon as possible following the preparation of such report, the Department shall notify the Agency in writing of the total cost of such report, which cost shall include, but not be limited to, the costs of such feasibility studies. Ten copies of the feasibility report shall be sent to the Agency along with the written notification of its cost.

3. If the Department determines that a project, whether called the Agua Fria Project or otherwise, has been constructed on the basis of, or as a result of, such feasibility report as is prepared by the Department pursuant to such statute as arises out of said bill and this contract, the Agency shall repay to the Department one-seventh (1/7) of the cost of such feasibility report, that is stated in the notification of such cost received by the Agency from the Department pursuant to paragraph 2 hereof. Such repayment shall be made to the Department by the Agency in one lump sum on or before the one hundred and eightieth (180th) day from the date when the Agency receives written notice from the Department that the construction of such project has, in the Department's judgment, been completed. Upon repayment to the Department of such sum in full, this contract shall terminate and be of no further force or effect.

4. Upon every amount required to be paid by the Agency to the Department pursuant to paragraph 3 hereof which remains unpaid after it becomes due and payable, interest shall accrue at the rate of one-half (1/2) of one (1) percent per month of the amount of such delinquent payment

from and after the due date until it is paid, and the Agency hereby agrees to pay such interest; provided, that no such interest shall be charged to or be paid by the Agency under this paragraph unless such delinquency continues for more than thirty (30) days.

5. No assignment or transfer of this contract or any part hereof, rights hereunder, or interest herein by the Agency shall be valid unless and until it is approved by the Department and made subject to such reasonable terms and conditions as the Department may impose.

6. This contract and all of its provisions shall apply to and bind the successors and assigns of the parties hereto.

7. All notices that are required either expressly or by implication to be given by one party to the other under this contract shall be signed for the Department by its Director and for the Agency by such officers as it may, from time to time, authorize in writing to so act. All such notices shall be deemed to have been given and all payments that are required to be made by the Agency under this contract shall be deemed to have been tendered if delivered personally or if enclosed in a properly addressed postage-prepaid envelope and deposited in a United States Post Office for delivery by registered or certified mail. Unless and until formally notified otherwise, all notices shall be addressed to the parties at their addresses as shown beneath the names of the persons who signed this contract.

8. This contract shall become null and void and of no further force or effect if said Senate Bill 1180 is not enacted into operative law.

IN WITNESS WHEREOF, the parties hereto have executed this contract as of the date first hereinabove written.

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Approved as to legal
form and sufficiency:

/s/ P. A. Towner
Chief Counsel
Department of Water Resources

By /s/ William E. Warne
Director

Address: P. O. Box 388
Sacramento, California

/s/ Dean C. Lauritzen
Attorney for
Mariposa County Water Agency

MARIPOSA COUNTY WATER AGENCY

By /s/ Fred W. Miller

Address: Courthouse
Mariposa, Califor

DEPARTMENT OF FINANCE
A P P R O V E D
Jul 17 1963

/s/ Robert L. Harkness
Deputy Director

APPENDIX C

COMMENTS OF THE

DEPARTMENT OF PUBLIC HEALTH

) of California

Department of Public Health

emorandum

: Department of Water Resources
San Joaquin Branch
1720 Fulton
Fresno, California

Date : February 11, 1964

Subject: Agua Fria Project
Mariposa County

. : Mr. Carl Stetson, Chief

: State Department of Public Health
Bureau of Sanitary Engineering
631 J Street
Sacramento, California

We have reviewed the proposed Agua Fria Project now in the feasibility phase of analysis.

The Agua Fria Project proposes a dam and reservoir to be located on Mariposa Creek below the confluence with Agua Fria Creek, approximately six miles downstream from the Community of Mariposa. The proposed uses of the reservoir include water supply, and all forms of water contact recreation including fishing and boating.

Water supply development is proposed to serve the recreational facilities as well as private land some four square miles in area on the watershed. These lands may be developed for home sites. A second domestic water supply is proposed to be transported through the dam pipeline to a lined canal, forebay and treatment plant in the Cathay Valley approximately ten miles down stream.

The Community of Mariposa treats and disinfects its sewage near Mariposa Creek with ultimate discharge of sewage effluent in Mariposa Creek through percolation and seepage in the stream gravels.

The public health aspects of the proposed development concerns the integrity of the domestic water and safe sewage treatment and disposal primarily in the vicinity of the reservoir. Recommendations are as follow:

1. Domestic water to be used in the vicinity of the reservoir and in the Cathay Valley must be provided with complete treatment including chemical coagulation, settling, filtration and disinfection.

2. Since considerable development will be urged and can be expected on the reservoir watershed, adequate sewage collection treatment and disposal must be included in the feasibility study. The soils generally found on the proposed watershed cannot be expected to provide reliable subsurface leaching areas. We strongly urge that a reliable collection system on the watershed extend to adequate treatment and disposal facilities downstream from the reservoir.

3. We urge that proposed reservoir clearance be adopted. Taste and odor problems in the treatment of the water for domestic uses can be expected to be transitory and will disappear in a reasonable time. Complete clearance in the area of the water intake and bathing areas are justified for protection of the intake and safety in the bathing areas.

4. In areas of high use we recommend the use of an adequate number of pump-out type, movable, chemical toilets. These units should be maintained no closer than 50 feet from the high water line. They, as well as all other facilities must be under the control and supervision of competent organization.

5. Any operation, maintenance, or discharge of wastes from the chemical toilets, fish cleaning and boat washing facilities, garbage and rubbish collection must have prior approval from the Mariposa County Health Department.

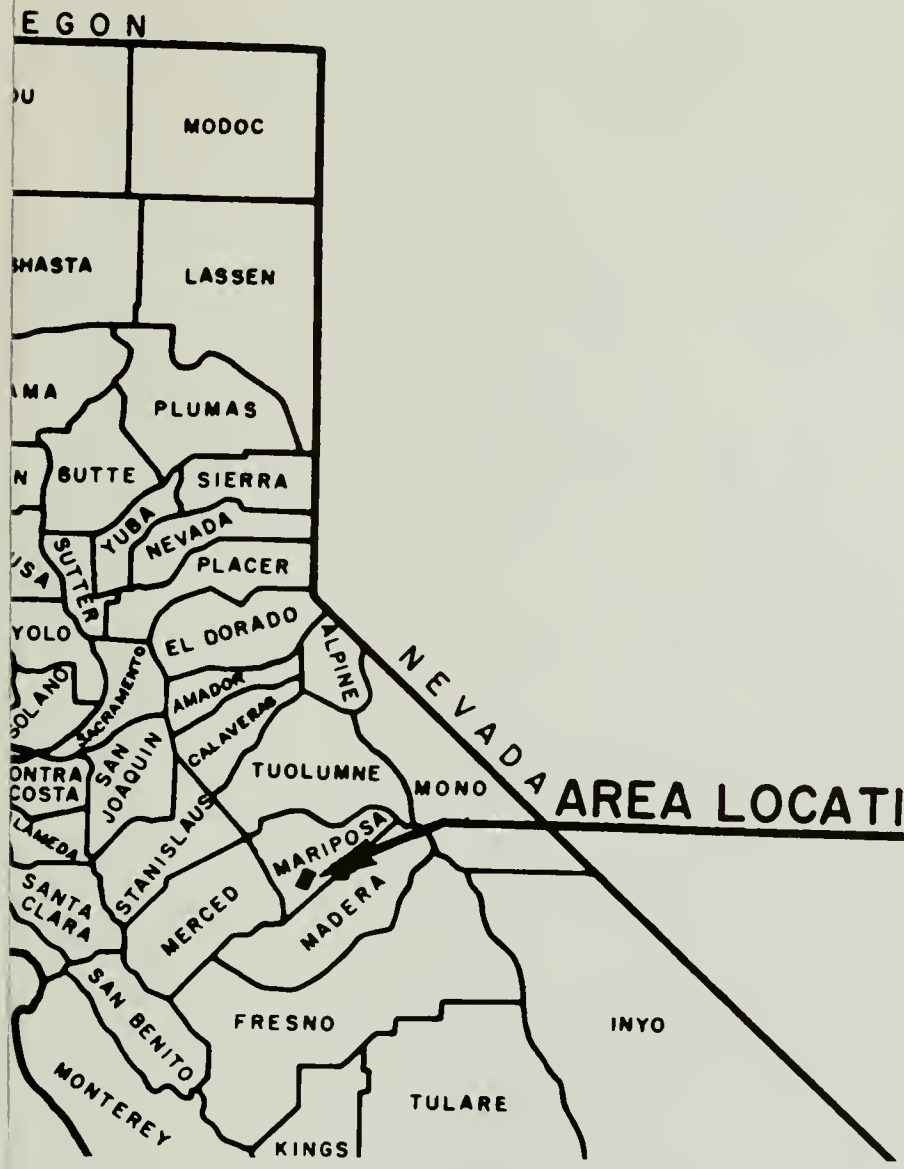
6. From the safety standpoint, and to further protect the domestic water to be transported to Cathay Valley, no recreation use of water can be allowed within 1000 feet of the outlet of the reservoir.

If you have further questions regarding this subject please feel free to call on us.

H. B. Foster, Jr., Chief
BUREAU OF SANITARY ENGINEERING

Morgan E. Stewart
Morgan E. Stewart
Supervising Sanitary Engineer

MES
ESC/dk
cc: J. Tibbens - Water Resources - Fresno
Mariposa County Health Department
BSE - Berkeley
Fresno



OCATION OF AREA OF INVESTIGATION

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

GUA FRIA PROJECT, FEASIBILITY STUDIES

LOCATION OF INVESTIGATED AREA AND REGIONAL GEOLOGIC MAP AGUA FRIA DAMSITE

MARIPOSA COUNTY

Scale: 1: 24000 C.I.= 20 & 50 Feet

DECEMBER 1963

LEGEND

Stratigraphy

QUATERNARY

Qal Alluvium
Unsorted, unconsolidated stream and colluvial deposits. Locally reworked by placer gold operations.

MESOZOIC

Jgr Granite Rock
Medium-grained acidic igneous intrusive rock. Locally, extensively decomposed granitic mantle developed on surface by deep weathering process.

Jgc Guadalupe Complex
Undifferentiated fine to medium-grained intrusive acidic igneous rock. Includes a north-south trending injection breccia zone.

Sp Serpentine
Altered ultrabasic dikes and sills; often sheared and contorted with slickensides often developed in sheared zones.

Jm Mariposa Formation
Predominantly black slate with some sandstone and conglomerate members. At damsite, this formation was recrystallized to schist and hornfels by contact metamorphism.

mv Metavolcanic Rocks
Consist of volcanic flow, breccia, agglomerate and tuff of pyroxene andesite and basalt; commonly referred to as "greenstones."

PALEOZOIC

Cc Calaveras Formation
Consists of hornfels, schist, phyllite, chert, quartzite, and slate.

Igneous Intrusive Rocks

SYMBOLS

——— Geologic contact. Dashed where inferred.

NOTES

1. Base map is portion 15 minute U.S.G.S. Mariposa Quadrangle, C.I.= 50 ft., 1947, and Cathay Quadrangle, C.I.= 20 ft., 1962 (preliminary).
2. Geology in part after California Division of Mines, Geologic Guidebook along Highway 49--Sierran Gold Belt, Bull., 141, Sept. 1948, and Taliaferro, N.L., unpublished geologic mapping in the Indian Gulch Quadrangle, Univ. of California, 1957.

SCALE IN MILES

0

LOCATION OF AREA OF INVESTIGATION

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

AGUA FRIA PROJECT, FEASIBILITY STUDIES

LOCATION OF INVESTIGATED AREA AND REGIONAL GEOLOGIC MAP AGUA FRIA DAMSITE

MARIPOSA COUNTY

Scale 1: 24000 C.I.= 20 & 50 Feet

DECEMBER 1963

LEGEND

uvium
cumulation of large angular boulders along stream
annel.

vium
consolidated, poorly sorted, stream deposited sand
d gravel.

posa Formation
edominantly a gray-black quartz-mica schist, some
rnfels, phyllite, chiastolite schist, and quartzite.

Mariposa Formation, bedrock concealed by weathering and soil cover.

Mariposa Formation, bedrock outcrop.

SYMBOLS

Geologic contact, approximately located

Inclined bedding attitude

Inclined joint attitude

Vertical joint attitude

Quartz vein

Foundation drill hole, vertical

Foundation drill hole, inclined

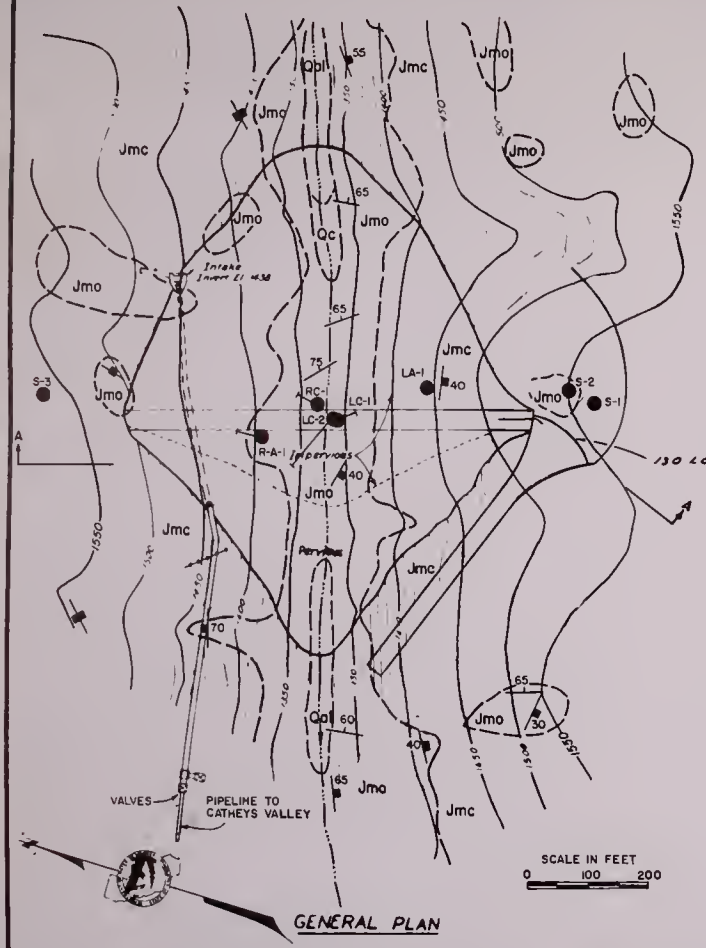
Foundation drill hole in cross-section

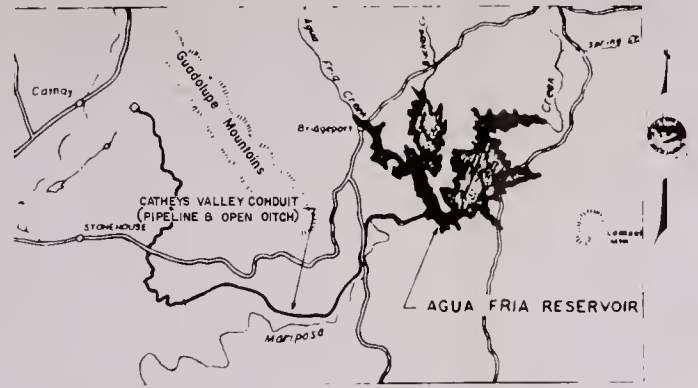
Location of cross-section

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

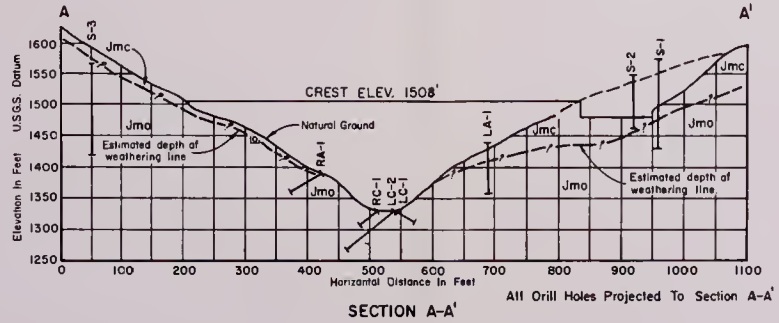
AGUA FRIA PROJECT, FEASIBILITY STUDIES

AREAL GEOLOGY & SECTION A-A'
AGUA FRIA DAMSITE
MARIPOSA COUNTY
JANUARY 1964





PROJECT AREA



SECTION A-A'

All Drill Holes Projected To Section A-A'

LEGEND

Qc Colluvium
Accumulation of large angular boulders along stream channel.

Qal Alluvium
Unconsolidated, poorly sorted, stream deposited sand and gravel.

Jm Mariposa Formation
Predominantly a gray-black quartz-mica schist, some hornfels, phyllite, chiastolite schist, and quartzite.

- **Jmc** Mariposa Formation, bedrock concealed by weathering and soil cover.
- **Jmo** Mariposa Formation, bedrock outcrop.

SYMBOLS

- Geologic contact, approximately located
- 60 — Inclined bedding attitude
- 60 — Inclined joint attitude
- Vertical joint attitude
- Quartz vein
- Foundation drill hole, vertical
- Foundation drill hole, inclined
- A — A' Foundation drill hole in cross-section
- Location of cross-section

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

AGUA FRIA PROJECT, FEASIBILITY STUDIES

AREAL GEOLOGY & SECTION A-A'
AGUA FRIA DAMSITE
MARIPOSA COUNTY
JANUARY 1964

LEGEND

Impervious

Quarry Rock

Sand and Gravel

Auger Hole Sample Point

Local materials source investigated by California Division of Highways, District X, Stockton, California, 1955, 1956, 1962

NOTE

ap is from U.S. Geological Survey 15 minute
sa Quadrangle (1948), C.I. = 50 feet, and
Quadrangle (1962-preliminary), C.I.= 20 feet.

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

FRIA PROJECT, FEASIBILITY STUDIES

TION OF CONSTRUCTION MATERIALS

AGUA FRIA DAMSITE

MARIPOSA COUNTY

cale: 1:24000 C.I.= 20 & 50 Feet

DECEMBER 1963

LEGEND

- Impervious
- Quarry Rock
- Sand and Gravel
- ● 5-A — Auger Hole Sample Point
- ○ — Local materials source investigated by California Division of Highways, District X, Stockton, California, 1955, 1956, 1962

NOTE

Base map is from U.S. Geological Survey 15 minute Mariposa Quadrangle (1948), C.I. = 50 feet, and Cathay Quadrangle (1962-preliminary), C.I.= 20 feet.

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DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

AGUA FRIA PROJECT, FEASIBILITY STUDIES

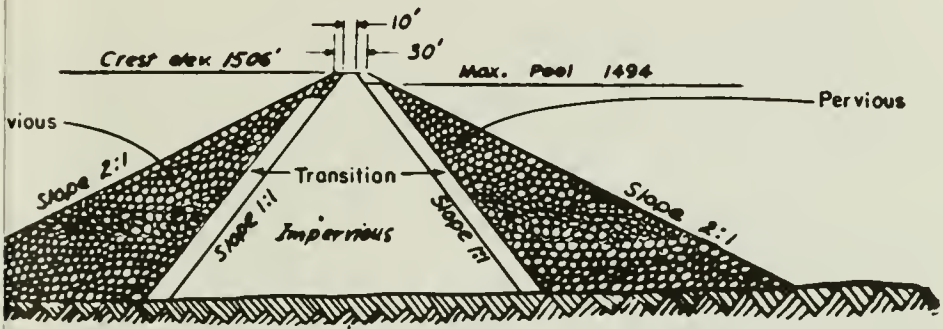
LOCATION OF CONSTRUCTION MATERIALS

AGUA FRIA DAMSITE

MARIPOSA COUNTY

Scale: 1:24000 C.I.= 20 & 50 Feet

DECEMBER 1963



SECTION OF DAM

SCALE IN FEET

100 0 100

STATE OF CALIFORNIA

THE RESOURCES AGENCY OF CALIFORNIA

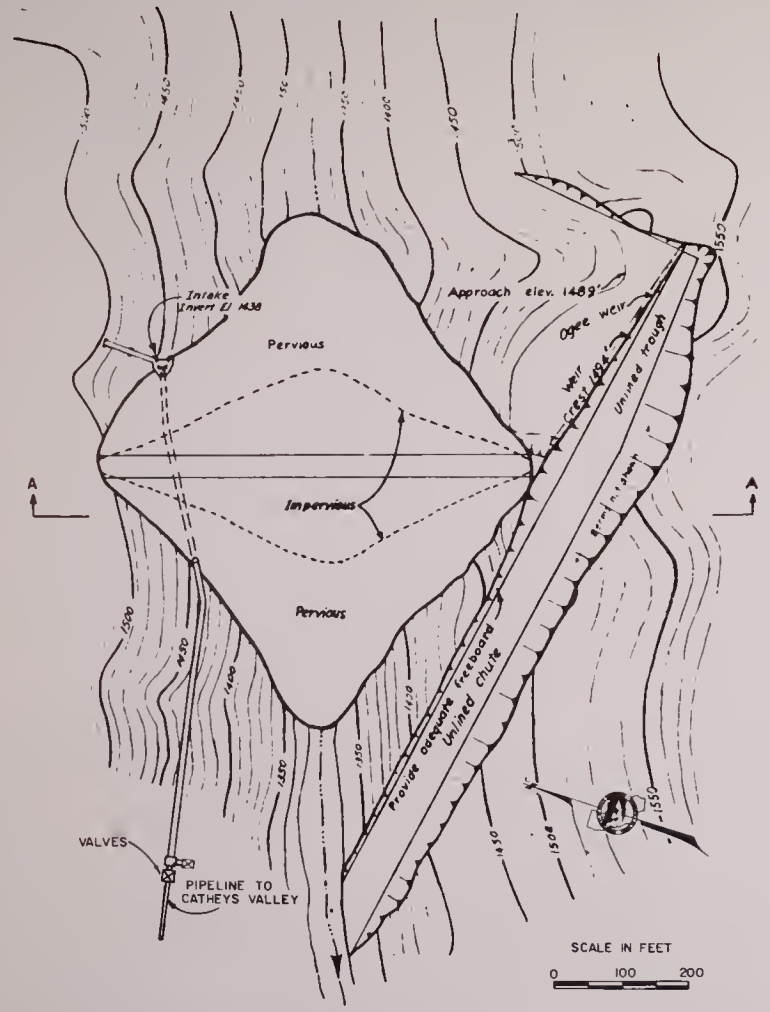
DEPARTMENT OF WATER RESOURCES

SAN JOAQUIN VALLEY BRANCH

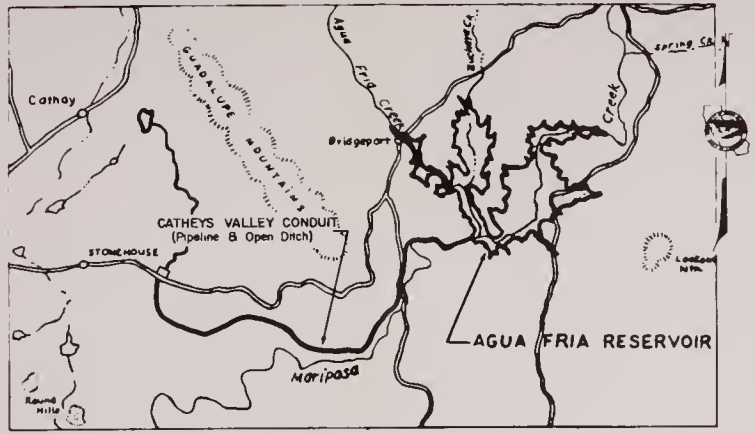
AGUA FRIA PROJECT, FEASIBILITY STUDIES

PRELIMINARY DESIGN

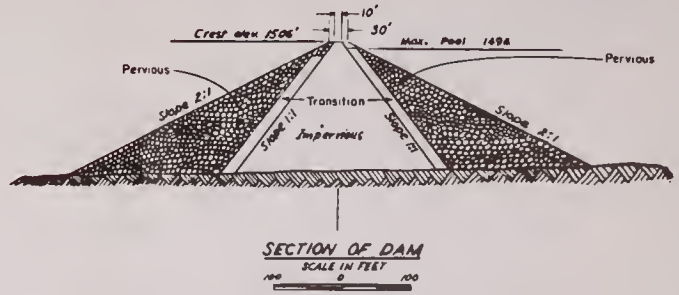
SCHEME I



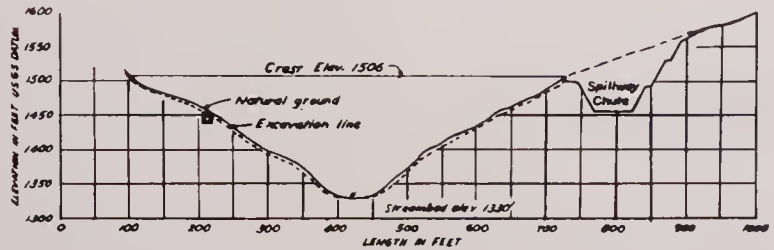
GENERAL PLAN



PROJECT AREA



SECTION OF DAM
SCALE IN FEET
100 0 100

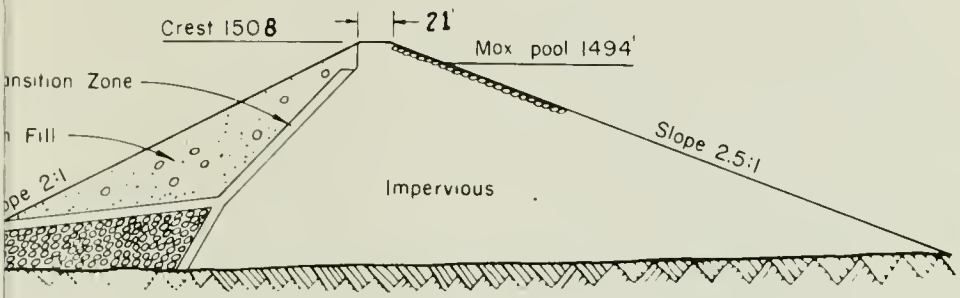


SECTION A-A

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

AGUA FRIA PROJECT, FEASIBILITY STUDIES

PRELIMINARY DESIGN
SCHEME I



SECTION OF DAM

SCALE IN FEET

100 0 100

STATE OF CALIFORNIA

THE RESOURCES AGENCY OF CALIFORNIA

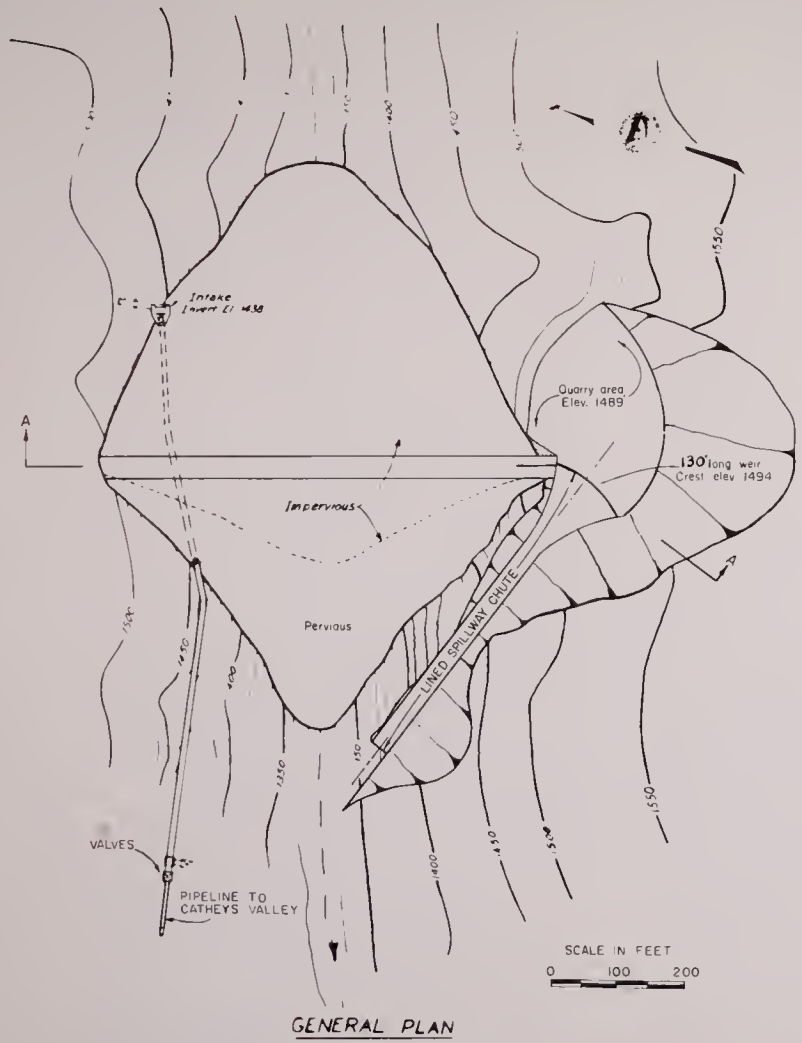
DEPARTMENT OF WATER RESOURCES

SAN JOAQUIN VALLEY BRANCH

AGUA FRIA PROJECT, FEASIBILITY STUDIES

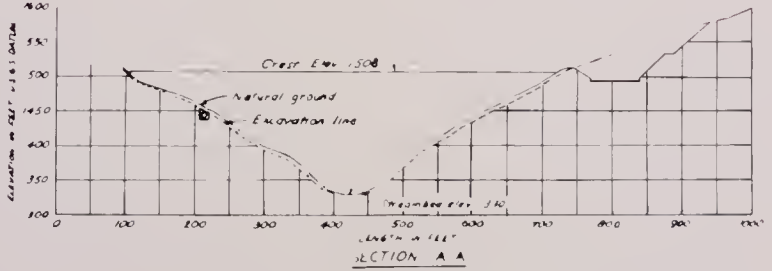
PRELIMINARY DESIGN

SCHEME 2

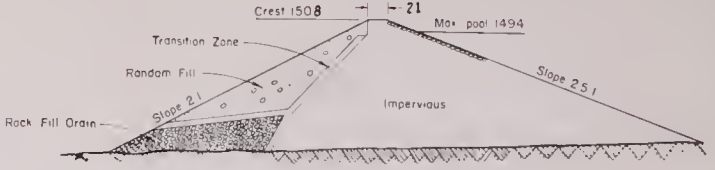


GENERAL PLAN

PROJECT AREA



SECTION A-A



SECTION OF DAM

SCALE IN FEET
60 0 60

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

AGUA FRIA PROJECT, FEASIBILITY STUDIES

PRELIMINARY DESIGN
SCHEME 2

ROAD CLASSIFICATION

- County road to be abandoned
- County road to be relocated
- Relocated county road
- Primary county road
- Secondary county road
- Unimproved road

SYMBOLS

- New bridge

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
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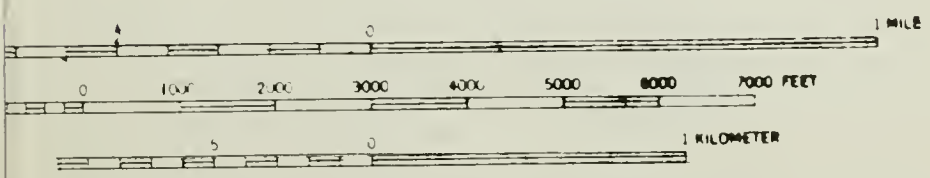
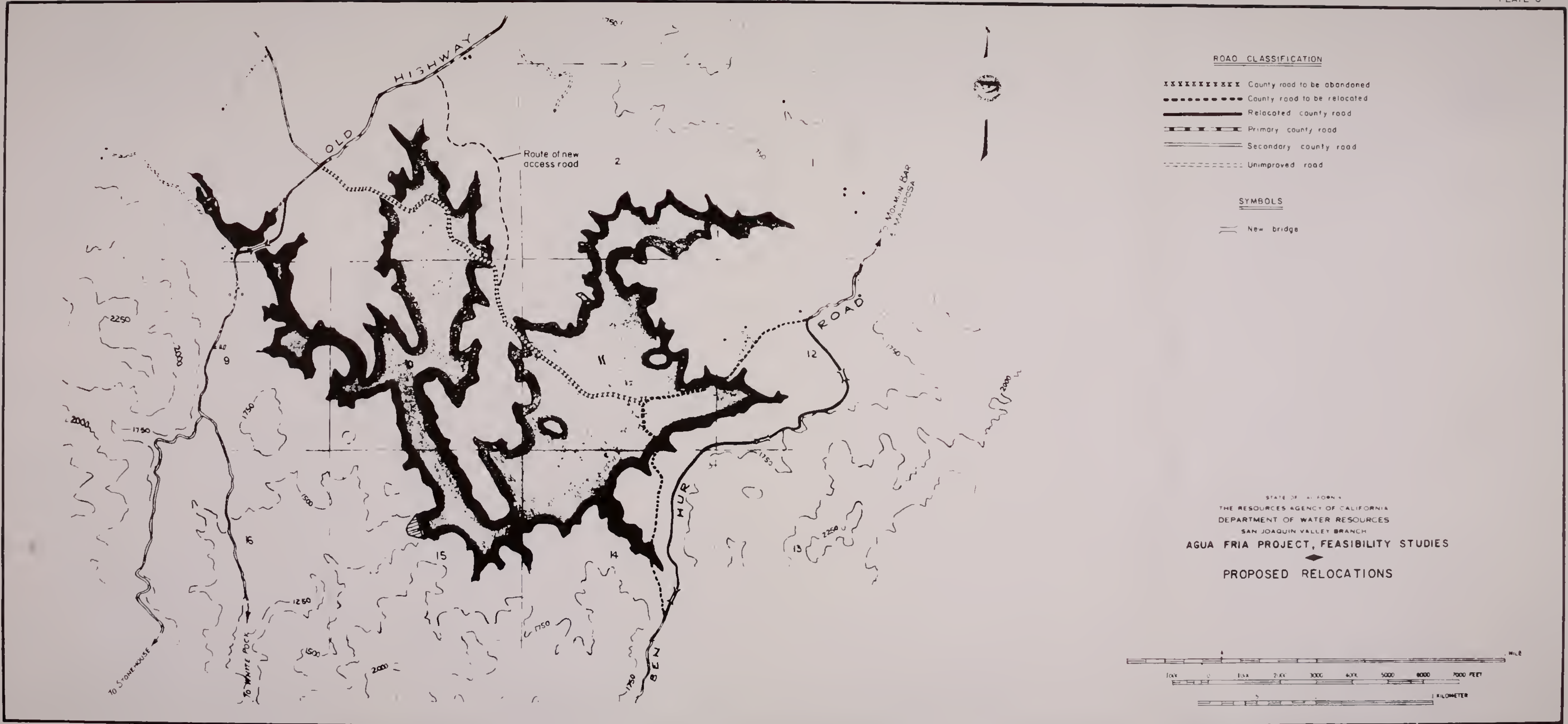
SAN JOAQUIN VALLEY BRANCH

AGUA FRIA PROJECT, FEASIBILITY STUDIES

PROPOSED RELOCATIONS




ROAD CLASSIFICATION
County road to be abandoned
County road to be relocated
Relocated county road
Primary county road
Secondary county road
Unimproved road
SYMBOLS
New bridge
OLD HIGHWAY
Route of new access road
ROAD
BEN HUR
TO MORMON BAR & MARIPOSA
TO STONEHOUSE
TO WHITE ROCK
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
AGUA FRIA PROJECT, FEASIBILITY STUDIES
PROPOSED RELOCATIONS
1 MILE
3000
4000
5000
6000
7000 FEET
1 KILOMETER

SYMBOLS :

Proposed recreation area

Property boundary line

Proposed acquisition boundary

Proposed water treatment and storage

STATE OF CALIFORNIA
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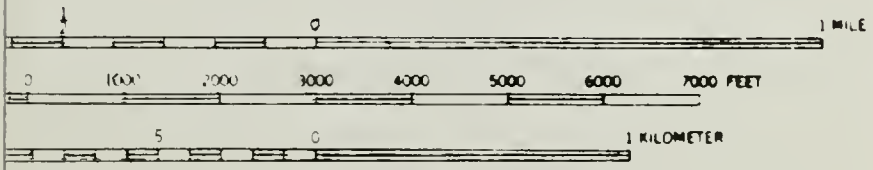
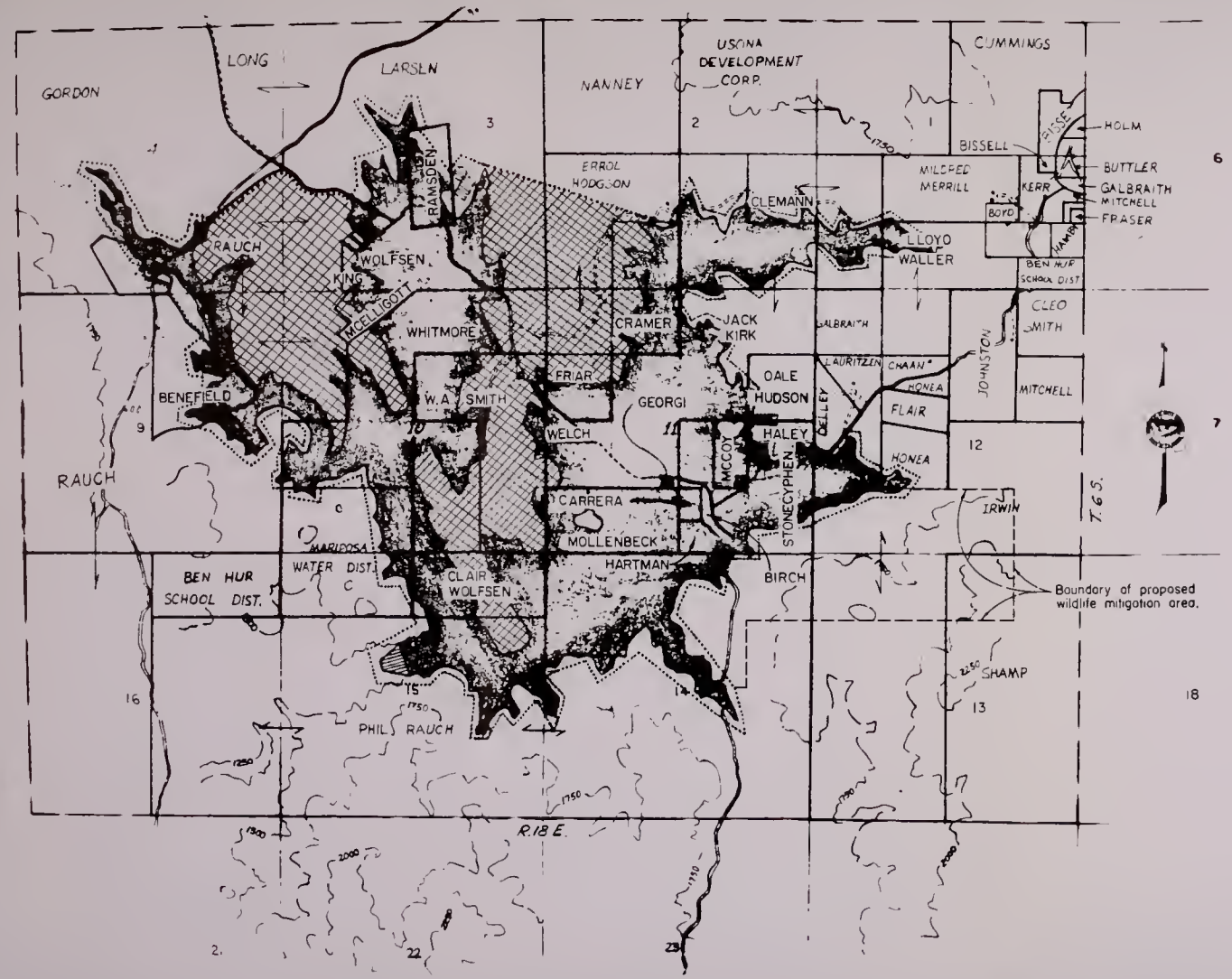
SAN JOAQUIN VALLEY BRANCH

FRIA PROJECT, FEASIBILITY STUDIES

NERSHIP AND PROPOSED ACQUISITION LINES





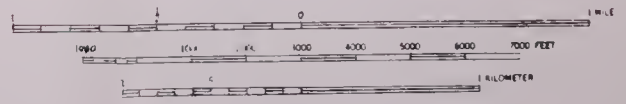
SYMBOLS:

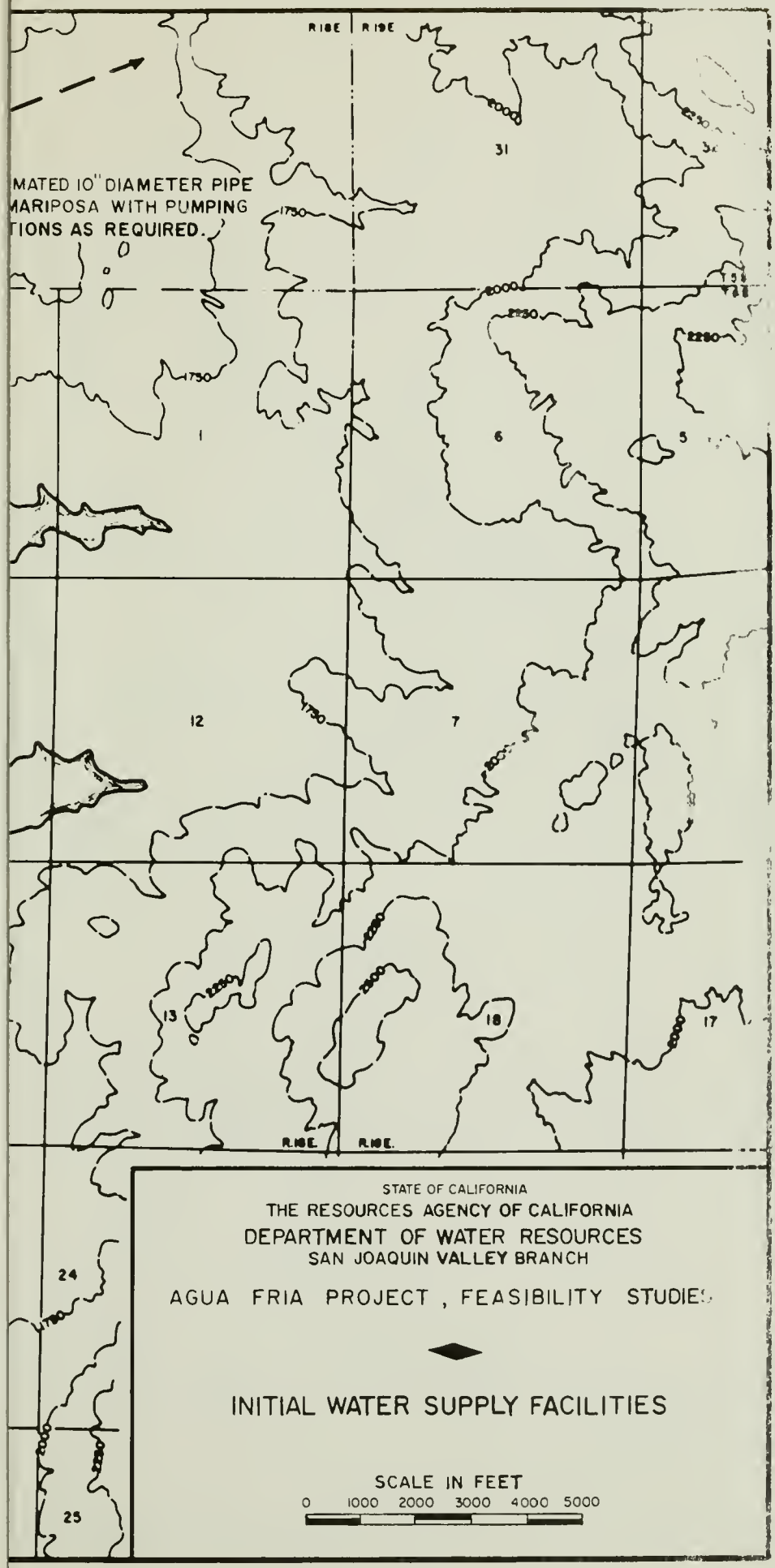
- Proposed recreation area
- Property boundary line
- Proposed acquisition boundary
- Proposed water treatment and storage

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

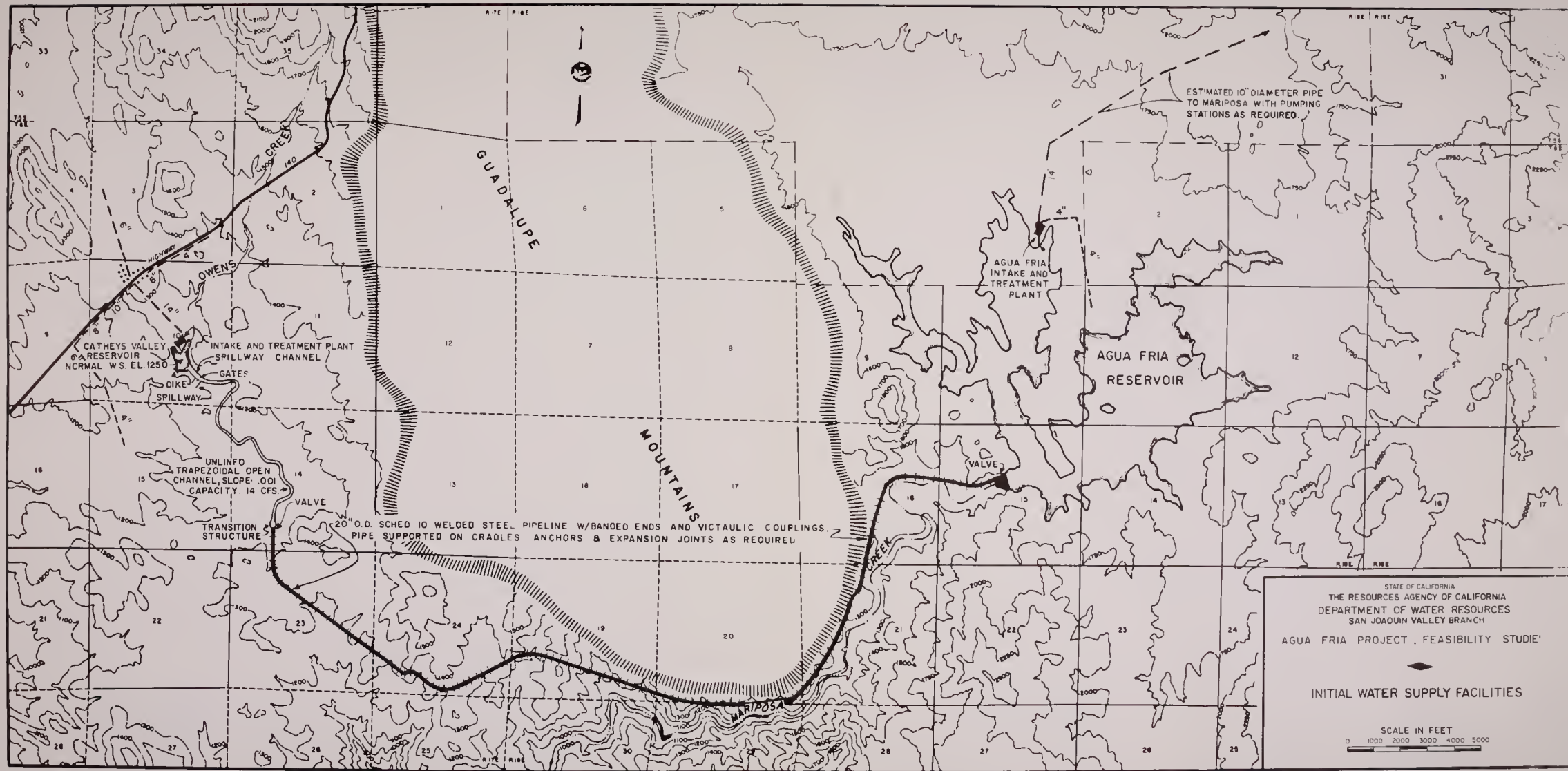
AGUA FRIA PROJECT, FEASIBILITY STUDIES

LAND OWNERSHIP AND PROPOSED ACQUISITION LINES




R.19E.
R.19E.
MATED 10" DIAMETER PIPE
MARIPOSA WITH PUMPING
TIONS AS REQUIRED.
31
1750
2000
2250
1
6
5
12
7
13
18
17
24
25
R.19E.
R.19E.
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
AGUA FRIA PROJECT, FEASIBILITY STUDIES
INITIAL WATER SUPPLY FACILITIES
SCALE IN FEET
0 1000 2000 3000 4000 5000

PLATE



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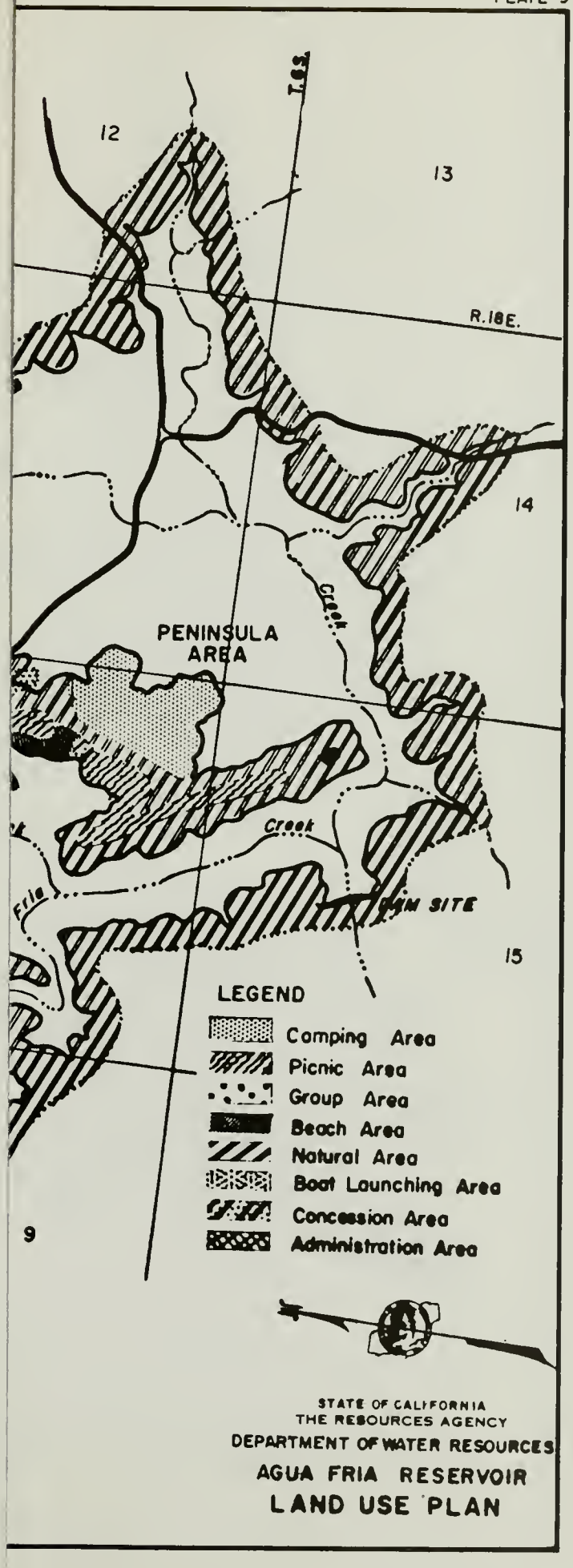
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH

AGUA FRIA PROJECT, FEASIBILITY STUDIES

INITIAL WATER SUPPLY FACILITIES

SCALE IN FEET
0 1000 2000 3000 4000 5000


12
13
T.6S.
R.18E.
14
PENINSULA
AREA
Creek
Creek
Fria
DAM SITE
15
9
LEGEND
Camping Area
Picnic Area
Group Area
Beach Area
Natural Area
Boat Launching Area
Concession Area
Administration Area
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
AGUA FRIA RESERVOIR
LAND USE PLAN

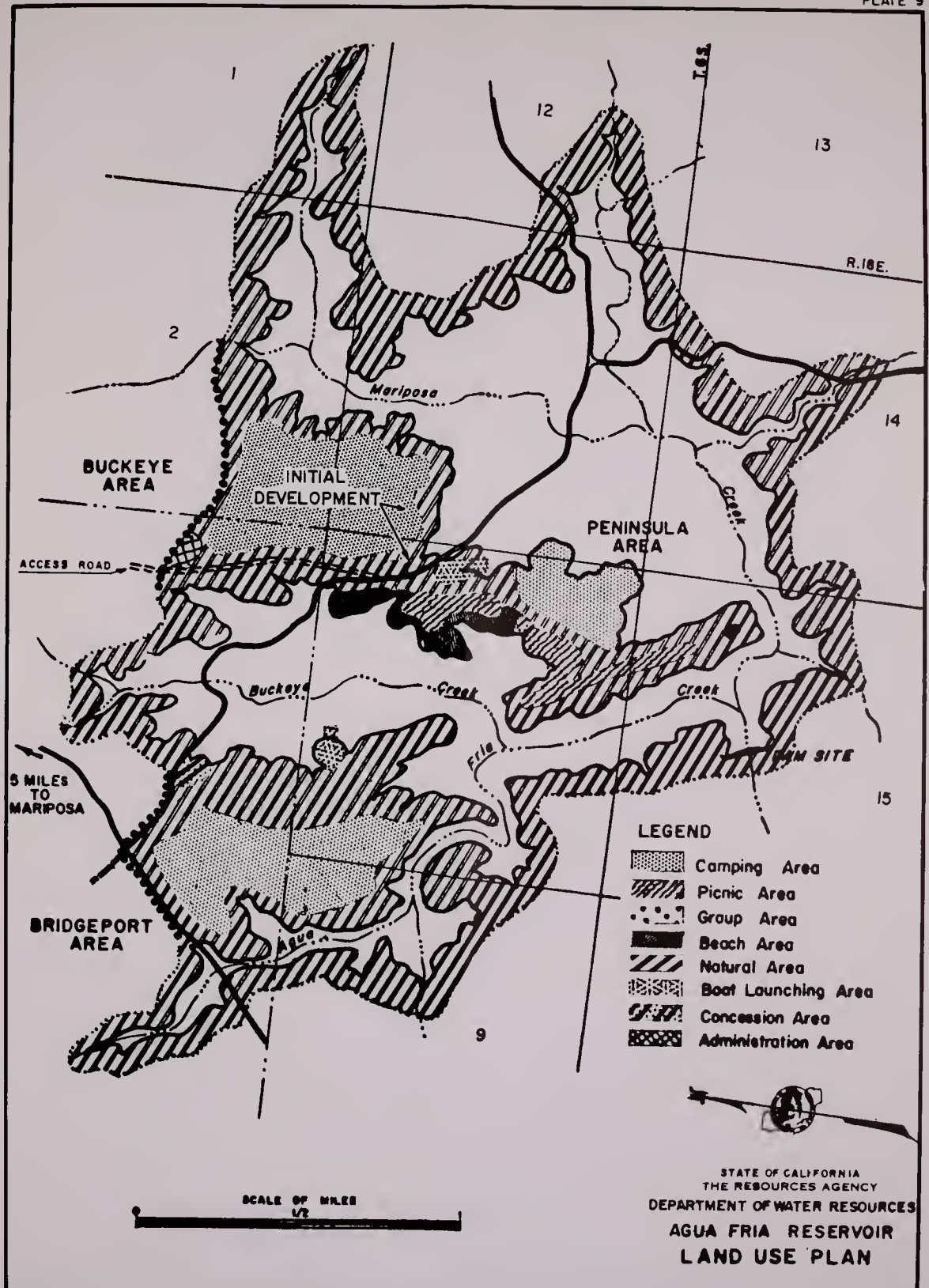

1
12
13
T.6S.
R.18E.
2
Mariposa
14
BUCKEYE AREA
INITIAL DEVELOPMENT
Creek
PENINSULA AREA
ACCESS ROAD
Buckeye
Creek
Creek
Fria
SITE
15
5 MILES TO MARIPOSA
BRIDGEPORT AREA
Agua
9
LEGEND
Camping Area
Picnic Area
Group Area
Beach Area
Natural Area
Boat Launching Area
Concession Area
Administration Area
SCALE OF MILES
1/2
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
AGUA FRIA RESERVOIR
LAND USE PLAN

PLATE 10

LOCATION MAP

SERVOIR

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

SAN JOAQUIN VALLEY BRANCH

PLAN FOR THE DEVELOPMENT ITIAL RECREATION FACILITIES AT AGUA FRIA RESERVOIR

0 100 200 300 400 500 600 FEET

CALE

CONTOUR INTERVAL 10 FEET

PLATE 10


CAMPING AREA
37 UNITS
PICNIC AREA
200 UNITS
SWIMMING BEACH
1 ACRE
300 CARS
PARKING
BOAT TRAILER
CAR PARKING
LAUNCHING RAMP
CONCESSION AREA
2 ACRES
AGUA FRIA RESERVOIR
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
1380
1370
1360
1350
1340
1330
1320
1310
1300
LOCATION MAP
T5S
T6S
R1BE
LEGEND
RECREATION AREA BOUNDARY
INITIAL DEVELOPMENT COMBINATION BLDG. (FLUSH)
INITIAL DEVELOPMENT REST ROOM (CHEMICAL)
FUTURE DEVELOPMENT REST ROOM (FLUSH)
FUTURE DEVELOPMENT COMBINATION BLDG. (FLUSH)
BOULDER OR ROCK OUTCROP
MAJOR VEGETATIVE OUTLINE
SHORE LINE, NORMAL POOL ELEV. 1494'
INITIAL DEVELOPMENT ROAD, CAMP UNIT
FUTURE DEVELOPMENT ROAD, CAMP UNIT
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
A PLAN FOR THE DEVELOPMENT OF INITIAL RECREATION FACILITIES AT AGUA FRIA RESERVOIR
SCALE
0 100 200 300 400 500 600 FEET
CONTOUR INTERVAL 10 FEET

PLATE II

5 S
6 S

OLS
undary
ad Or Highway

LIFORNIA
CY OF CALIFORNIA
TER RESOURCES
LLEY BRANCH
EASIBILITY STUDIES

OJECT ZONE
MILES

PLATE II

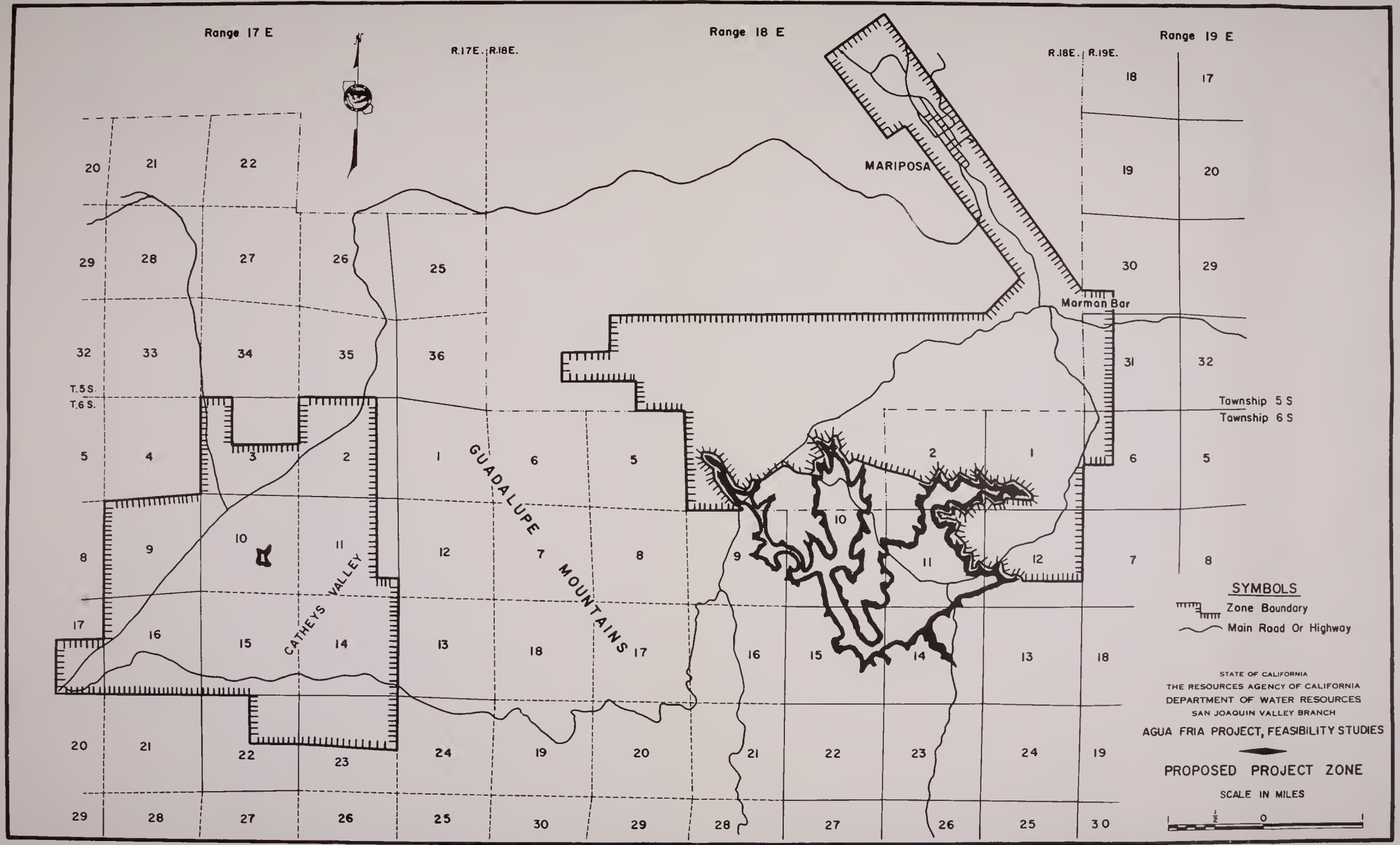

Range 17 E
Range 18 E
Range 19 E
R.17E.
R.18E.
R.18E.
R.19E.
MARIPOSA
Marman Bar
T.5S.
T.6S.
Township 5 S
Township 6 S
GUADALUPE MOUNTAINS
CATHEYS VALLEY
SYMBOLS
Zone Boundary
Main Road Or Highway
STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SAN JOAQUIN VALLEY BRANCH
AGUA FRIA PROJECT, FEASIBILITY STUDIES
PROPOSED PROJECT ZONE
SCALE IN MILES
½ 0 1

TABLE 15

	Financial Summary					
	Total	Net Annual Revenue	Balance At End of Prior Year	Interest on Balance at 4%	Reserve Balance at end of Year	Year
	24 (22+23)	25	26	27 (26x4%)	28 (25+26+27)	
	6.000	13.400			13,400	1966
		15,100	13,400	500	29,000	67
		16,400	29,000	1,200	46,600	68
		18,000	46,600	1,900	66,500	69
	34.700	40,400	66,500	2,700	109,600	1970
05/	136.200	-40,500	109,600	4,400	73,500	71
	140.200	-25,600	73,500	2,900	50,800	72
	143.500	-10,500	50,800	2,000	42,300	73
	146.600	4,400	42,300	1,700	48,400	74
	149.900	20,500	48,400	1,900	70,800	75
06/	149.400	39,700	70,800	2,800	113,300	76
	152.600	-10,900	113,300	4,500	106,900	77
	155.900	- 1.400	106,900	4,300	109,800	78
	159.000	8,400	109,800	4,400	122,600	79
07/ 08/	187.400	- 7,200	122,600	4,900	120,300	1980
	190,200	1,300	120,300	4,800	126,400	81
	193.100	9,900	126,400	5,100	141,400	82
	195,800	- 8,600	141,400	5,700	138,500	83
	198.600	- 1,800	138,500	5,500	142,200	84
	201.300	- 1.000	142,200	5,700	146,900	85
	204.200	5,600	146,900	5,900	158,400	86
	207.000	12,500	158,400	6,300	177,200	87
	209,700	-15,500	177,200	7,000	168,700	88
	212,600	-10,200	168,700	6,800	165,300	89
	215,400	- 5,000	165,300	6,600	166,900	1990
	250,500	-32,100	166,900	6,700	141,500	91
	253,500	-28,200	141,500	5,700	119,000	92
	256,600	-24,200	119,000	4,800	99,600	93
	259,800	-19,600	99,600	4,000	84,000	94
	262,700	-14,700	84,000	3,400	72,700	95
	265,700	- 9,900	72,700	2,900	65,700	96
	267,700	- 3,600	65,700	2,600	64,700	97
	271,800	- 5,800	64,700	2,600	61,500	98
	274,800	- 700	61,500	2,500	63,300	99
	278,000	- 2,500	63,300	2,500	63,300	2000
						01
						02
						03
						04
						05
						06
						07
						08
						09
						2010
						11
						12
						13
						14
		-63.300		0	0	15

d.

7/ Repayment of loan for second stage of water supply facilities.

8/ Repayment of private loan for third stage of water supply facilities.

TABLE 15
FINANCIAL FEASIBILITY STUDY
REPAYMENT ANALYSIS (In dollars)

Year	Revenues: Water Tolls: Urban: Domestic: Toll 1/	Urban: Domestic: Revenue	Urban: Commercial: Toll 1/	Urban: Commercial: Revenue	Rural Homesite: Domestic: Toll 1/	Rural Homesite: Domestic: Revenue	Agriculture: Suppl. Irrig. 2/: Toll	Agriculture: Suppl. Irrig. 2/: Revenue	Agriculture: Orchard: Toll 3/	Agriculture: Orchard: Revenue	Agriculture: Pasture: Toll 3/	Agriculture: Pasture: Revenue	Total Water Toll Revenue	Ad Valorem Taxes: Agency Area: Assessed Valuation(000)	Agency Area: Tax 4/: Rate	Agency Area: Revenue	Project Zone: Assessed Valuation(000)	Project Zone: Tax 4/: Rate	Project Zone: Revenue	Total Tax Revenue	Total Revenue Tolls and Taxes	Expenditures: O&M+R	Debt Service	Total	Financial Summary: Net Annual Revenue	Balance At End of Prior Year	Interest on Balance at 4%	Reserve Balance at end of Year	Year
	1	2	3	4	5	6	7	8	9	10	11	12	13 (2+4+6+8+10+12)	14	15	16 (14x15)	17	18	19 (17x18)	20 (13+20)	21	22	23A	23B	24 (22+23)	25	26	27 (26x4%)	28 (25+26+27)	
1966														13,000	0.10	13,000	1,600	0.40	6,400	19,400	19,400	6,000			6,000	13,400			13,400	1966
67														13,500		13,500	1,900		7,600	21,100	21,100					15,100	13,400	500	29,000	67
68														14,000		14,000	2,100		8,400	22,400	22,400					16,400	29,000	1,200	46,600	68
69														14,400		14,400	2,400		9,600	24,000	24,000					18,000	46,600	1,900	66,500	69
1970	8.00	12,200	16.00	10,200	8.00	12,800	30.00	12,000	10.00	500	4.00	2,100	49,800	14,900		14,900	2,600		10,400	25,300	75,100	34,700			34,700	40,400	66,500	2,700	109,600	1970
71		17,300		12,200		20,000		14,000		1,000		4,200	68,700	15,400		15,400	2,900		11,600	27,000	95,700	37,100		99,100 5/	136,200	-40,500	109,600	4,400	73,500	71
72		22,400		14,100		27,300		15,900		1,500		5,100	86,300	15,900		15,900	3,100		12,400	28,300	114,600	41,100			140,200	-25,600	73,500	2,900	50,800	72
73		27,500		16,000		34,400		18,000		2,000			103,000	16,400		16,400	3,400		13,600	30,000	133,000	44,400			143,500	-10,500	50,800	2,000	42,300	73
74		32,600		17,900		41,700		20,000		3,000			120,300	16,800		16,800	3,600		14,400	31,200	151,000	47,500			146,600	4,400	42,300	1,700	48,400	74
75		37,800		19,800		48,900		21,900		4,000			137,500	17,300		17,300	3,900		15,600	32,900	170,400	50,800			149,900	20,500	48,400	1,900	70,800	75
76		42,900		21,800		56,200		23,900		5,000			154,900	17,800		17,800	4,100		16,400	34,200	189,100	53,900		95,500 6/	149,400	39,700	70,800	2,800	113,300	76
77	6.00	36,000	12.00	17,800	6.00	47,500	20.00	17,200	5.00	2,500	1.50	2,600	123,600	18,500	0.05	9,300	4,400	0.20	8,800	18,100	141,700	57,100			152,600	-10,900	113,300	4,500	106,900	77
78		39,800		19,200		53,000		18,600					135,700	19,200		9,600	4,600		9,200	18,800	154,500	60,400			155,900	- 1,400	106,900	4,300	109,800	78
79		43,700		20,600		58,400		19,900					147,700	19,800		9,900	4,900		9,800	19,700	167,400	63,500			159,000	8,400	109,800	4,400	122,600	79
1980		47,500		22,100		63,800		21,200					159,700	20,500		10,300	5,100		10,200	20,500	180,200	66,700		120,700 6/	187,400	- 7,200	122,600	4,900	120,300	1980
81		51,900		23,500		67,300		22,300					170,100	21,200		10,600	5,400		10,800	21,400	191,500	69,500			190,200	1,300	120,300	4,800	126,400	81
82		56,400		25,000		70,800		23,500					180,800	21,900		11,000	5,600		11,200	22,200	203,000	72,400			193,100	9,900	126,400	5,100	141,400	82
83	5.00	50,600	10.00	22,000	5.00	61,800		24,600					164,100	22,500		11,300	5,900		11,800	23,100	187,200	75,100			195,800	- 8,600	141,400	5,700	138,500	83
84		54,300		23,200		64,700		25,700					173,000	23,200		11,600	6,100		12,200	23,800	196,800	77,900			198,600	- 1,800	138,500	5,500	142,200	84
85		58,000		24,400		67,600		26,800					181,900	23,900		12,000	6,400	0.10	6,400	18,400	200,300	80,600			201,300	- 1,000	142,200	5,700	146,900	85
86		61,700		25,600		70,500		28,000					190,900	24,600		12,300	6,600		6,600	18,900	209,800	83,500			204,200	5,600	146,900	5,900	158,400	86
87		65,400		26,800		73,400		29,100					199,800	25,500		12,800	6,900		6,900	19,700	219,500	86,300			207,000	12,500	158,400	6,300	177,200	87
88	4.00	55,200	8.00	22,400	4.00	61,000		30,200					173,900	26,300		13,200	7,100		7,100	20,300	194,200	89,000			209,700	-15,500	177,200	7,000	168,700	88
89		58,200		23,400		63,300		31,400					181,400	27,200		13,600	7,400		7,400	21,000	202,400	91,900			212,600	-10,200	168,700	6,800	165,300	89
1990		61,100		24,300		65,600		32,500					188,600	28,100		14,200	7,600		7,600	21,800	210,400	94,700			215,400	- 5,000	165,300	6,600	166,900	1990
91		63,800		25,500		67,800		33,800					196,000	29,000		14,500	7,900		7,900	22,400	218,400	97,800	32,000 8/		250,500	-32,100	166,900	6,700	141,500	91
92		66,500		26,600		70,100		35,000				1,500	202,200	29,900		15,000	8,100		8,100	23,100	225,300	100,800			253,500	-28,200	141,500	5,700	119,000	92
93		69,200		27,800		72,300		36,300				500	208,600	30,800		15,400	8,400		8,400	23,800	232,400	103,900			256,600	-24,200	119,000	4,800	99,600	93
94		71,900		28,900		74,600		37,800					215,700	31,700		15,900	8,600		8,600	24,500	240,200	107,100			259,800	-19,600	99,600	4,000	84,000	94
95		74,600		30,100		76,800		38,800					222,800	32,500		16,300	8,900		8,900	25,200	248,000	110,000			262,700	-14,700	84,000	3,400	72,700	95
96		77,200		31,200		79,000		40,100					230,000	33,400		16,700	9,100		9,100	25,800	255,800	113,000			265,700	- 9,900	72,700	2,900	65,700	96
97		79,900		32,400		81,300		41,300					237,400	34,600		17,300	9,400		9,400	26,700	264,100	115,000			267,700	- 3,600	65,700	2,600	64,700	97
98		82,600		33,500		83,500	17.00	36,200					238,300	35,800		17,900	9,800		9,800	27,700	266,000	119,100			271,800	- 5,800	64,700	2,600	61,500	98
99		85,300		34,700		85,800		37,200					245,500	37,000		18,500	10,100		10,100	28,600	274,100	122,100			274,800	- 700	61,500	2,500	63,300	99
2000		88,000		35,800		88,000	14.00	31,700					246,000	38,200		19,100	10,400		10,400	29,500	275,500	125,300			278,000	- 2,500	63,300	2,500	63,300	2000
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15	2.50	56,350			2.50	56,350							182,700								212,200				-63,300		0	0	15

1/ Flat rate per month per connection.

2/ Home orchard garden area hobby pasture.

3/ Canalside charge, untreated water, per acre-foot.

4/ Rate per $100 assumed valuation.

5/ Interest payment only to end of development period in 1975. Includes annual interest plus deferred interest for period of 1966-70.

6/ Capital plus interest payments through balance of repayment period.

7/ Repayment of loan for second stage of water supply facilities.

8/ Repayment of private loan for third stage of water supply facilities.